



Physical Model Test for Bendway Weir Design Criteria

Waterway Simulation Technology, Inc.

October 2002

Physical Model Test for Bendway Weir Design Criteria

by Waterway Simulation Technology, Inc. 2791 Burnt House Road Vicksburg, MS 39180

Final report

Approved for public release; distribution is unlimited

Prepared for

U.S. Army Corps of Engineers

Washington, DC 20314-1000

Monitored by

Coastal and Hydraulics Laboratory

U.S. Army Engineer Research and Development Center

Vicksburg, MS 39180-6199

Contents

1—Introduction	1
BackgroundStudy Approach	
2—Design	
Existing Bendway Weir Project Design Method Data Analysis	2 3
3—Bendway Weir Field	
Constructed Bendway Weir Systems Greenfield Bend	10 11 12 13 14 15 16 17 18 20 20 22 23 24 25
4—Post Construction Analysis	28
Pilot General Comments Unconstructed Bendway Weir Systems Analysis of Reported Accidents Summary of Survey Results Navigation Changes Due to Bendways	29 29 31
5—Test Plan Development	33
Considerations for Developing Test Plan	33

Significant Factors for Test Plan	34
Test Environment, Scale, and Time of Operations	35
Proposed Physical Model Test Plan	37
Appendix A—U.S. Coast Guard Casualty Data (1993-1997)	A1
SF 298	

List of Figures

Figure 1.	Greenfield Bend10
Figure 2.	Eliza Point11
Figure 3.	Scudder's Landing12
Figure 4.	Dogtooth Bend
Figure 5.	Price's Landing14
Figure 6.	Cape Bend15
Figure 7.	Cape Rock16
Figure 8.	Picayune17
Figure 9.	Fountain Bluff18
Figure 10.	Red Rock19
Figure 11.	Kaskaskia Bend19
Figure 12.	St. Genevieve20
Figure 13.	Fort Chartres21
Figure 14.	Establishment23
Figure 15.	Carl Baer23
Figure 16.	Bellerive24
Figure 17.	Mosenthein/Chain of Rocks Canal
Figure 18.	Victory Bend26

Preface

The work described herein summarizes the results for physical model testing of bendway weir design criteria including conditions and design options needed for a model testing plan for determining navigation impacts.

The report was written and prepared by Waterway Simulation Technology, Inc., 2791 Burnt House Road, Vicksburg, MS. The work was monitored by the Inland Navigation Group, Coastal and Hydraulics Laboratory (CHL), U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, during the period June 1998 to September 2002. It was completed under Contract No. DACW 39-99-P-0443 in support of Research Work Unit No. 32256: Effects of Bendway Weirs on Navigation, No. 333, Inland Navigation.

Project Manager was Ms. Sandra Knight, Technical Director and former Chief, Navigation Branch, CHL. Principal Investigators were Mr. Don Wilson, Chief, Navigation Branch, CHL, and Mr. Michael Winkler, CHL. Other lab members involved were Mr. Keith Green and Ms. Peggy Van Norman, both of CHL.

During publication of this report, Dr. James R. Houston was Director of ERDC, and COL John W. Morris III, EN, was Commander and Executive Director.

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	Ву	To Obtain	
cubic feet	0.02831685	cubic meters	
feet	0.3048	meters	

1 Introduction

Background

During the last decade the U.S. Army Corps of Engineers has been placing structures called bendway weirs (submerged dikes) in river bends to improve stability of navigation channels and, consequently, reduce dredging. In some cases these weirs have improved navigation conditions, especially when physical models have been tested prior to construction to determine efficacy of the designs. However, for many constructed bendway weir systems either no model testing was performed or effects on tow navigation were not considered in their design. In one project physical model test, Montgomery Point Lock and Dam, some designs were tested which were shown by the model to create dangerous conditions for navigation, particularly for upbound tows. Some anecdotal stories from tow pilots concerning a few in-place weir systems have been received which claim difficult navigation conditions at various river stages. Some similar situations have been reported for submerged dike fields in lock approaches.

Study Approach

A multi-faceted approach was used to determine the range of conditions and various design options that need to be included in a model testing plan for determining navigation impacts of bendway weirs. A critical part of the effort was to identify all of the existing bendway and lock approach weir systems which have either been constructed or designed and awaiting construction. Furthermore, information concerning each of the weir systems was critical including design specifications, pre- and post-construction bottom surveys and navigation history, and flow conditions. Two U.S. Army Engineer Districts, Vicksburg and St. Louis, have designed and constructed bendway weir systems. These offices provided design materials such as as-built drawings, hydrographic surveys and flow histories for defining weir conditions. All the bendway weir systems investigated were located on the Mississippi River.

The plans, histories and designs were analyzed and categorized to define ranges of design parameters and conditions experienced at the weir systems since construction. Also, data bases were examined for these areas to identify accidents near the weir fields and conditions at the time. Questionnaires were sent to towing companies and their pilots to document incidents and opinions concerning pre- and post-construction navigation difficulties near the constructed weir fields. The companies contacted included American Commercial Barge Line, Ingram Towing, Brownwater Towing, and Midland.

2 Design

Existing Bendway Weir Project Design Method

Most of the bendway weir projects (95%) have been built in and were designed by the St. Louis District. Two of these projects were modeled, Dogtooth Bend at river mile 22 and Price's Landing at river mile 30. Dogtooth Bend was modeled both with physical and mathematical modeling and was monitored with extensive prototype measurements as the project developed through the years, including following the 1993 flood.

Since these first two projects, the other bendway weir projects have been designed with the following procedure:

- Photos of ice flows in the river are obtained and the flow patterns examined through the bend.
- Using the flow patterns of the ice in combination with the overall bend plan form, the general flow pattern would be drawn in the through the project bend.
- Based on bathymetry, the number of weirs that could physically be built would be determined. At least -25 LWRP is needed for developing a minimum 10 feet¹ structure section.
- All weirs were generally laid out at an angle 30 degrees to a line drawn
 perpendicular to flow (as drawn from the ice photo). However, about 3
 years into implementation, the angle of the last weirs was changed to
 bring flow into the crossing more in alignment with the channel. The last
 weir was place either perpendicular or slightly angled upstream into the
 flow.
- All weirs were built to a -15 LWRP.

Generally these projects were designed to reduce the maintenance requirements and develop a wider channel by forcing the point bar away from the outside bank of the bend. The redirection of the flow using the submerged weirs to erode the point bar also generally improved the navigation conditions by

¹ A table of factors for converting non-SI units of measurement to SI units is presented on page vi.

creating a more evenly distributed flow field. However, each weir field is unique and the development of the channel was dependent on the bed and bank conditions as well as the flow field. Some weir fields contain underlying rock strata, clay, and other non-erodible material that give a different bed response.

Data Analysis

For each weir system hydrographic survey sheets were used to identify certain design specifications. Hard-copies of the survey sheets were used to measure channel width and bend angles and to choose locations for tangents on the outside of each of the bends. Additionally, most of the weir systems had high resolution dredging survey data in CAD format which allowed close inspection of bottom contour details. For standardization, the bends were assumed to be circular and the tangent coordinates were used to calculate chord distances and bend radii. Because of the engineering judgment required for these measurements, the bend parameters identified in this report for the weir systems are approximate and should serve only as nominal values.

To establish a comparative measure of the effect of weir construction on the river bottom elevation, pre- and post-construction surveys were examined for minimum elevations immediately downstream of each of the weirs (or proposed weirs for the pre-surveys). Minimum elevations chosen from the CAD survey drawings were based on engineering judgment and represent approximate values for the purpose of before and after comparison. Weir height presented in this report is the vertical distance between two locations, one being the deepest point just downstream of the weir and the other being the top of the weir. To determine the orientation of the weirs with the upstream direction, a circular arc with the calculated radius was graphically placed over the dredging contour drawings and the angle formed at the intersection of the arc and each weir was measured. The distance between weirs was the length of a line from the end of the weir on the outside of the bend to the perpendicular intersection with the next weir downstream.

According to St. Louis District engineers all the weirs constructed in the middle Mississippi River have a top elevation of -15 ft below Low Water Reference Plane (LWRP). The weirs designed and constructed in the Vicksburg District had a weir-top elevation of -20 ft LWRP. Using these values and historical river stage records from gauging stations along the applicable reaches, the range of water depth over the weirs was calculated. Data from the gauging stations between River Mile (RM) 196 and RM 2 on the middle Mississippi and the gauging station at Arkansas City on the lower Mississippi were used to determine these depths. The 10th and 90th percentile, average, and minimum and maximum water depth over the weirs were calculated using the cumulative distribution from the river stage records and interpolating to the bendway weir system locations (for the Middle Mississippi). At Victoria Bend on the Lower Mississippi the stage record at Arkansas City was used to calculate water depth, after adjustment for the correct LWRP elevation at the weirs.

Chapter 2 Design 3

To document opinion of the navigation impacts of weir construction questionnaires were sent to tow pilots from several towing companies. The pilots were asked to give ratings to four questions aimed at determining whether tow navigation had been improved or degraded following construction of individual weir systems. Furthermore, anecdotal comments and opinions were elicited from the pilots to help identify navigational problem areas. Table 1 shows the questions asked and tabulates average ratings received from the pilots for most of the bendway weir systems. Pilot comments are included in the following section.

For this study seventeen weir systems constructed on the Middle Mississippi were investigated and one on the Lower Mississippi. Two weir systems on the Lower Mississippi are currently being designed; however, proposals for these systems were not final during the present study and little definitive information was available for the purpose of investigating navigation impacts. Details of each of the bendway weir systems are discussed below, including pilot comments directed at the specific location. Table 2 is compendium of design specifications for all the constructed weir systems.

This control The This						,														
The compound The			Ö	ficulty of	Control	ing Tow	in Bend			matic (Control Up	pound	Flant	ring Requi	red Down	1ponud	Nor	nal Spe	ed Upbo	pun
High Flow Low Flow High Flow High Flow Low Flow High Flow High Flow Low Flow High				1 = Easy	= 01	Very Dif	ficult			Post	Construct	ion?	0		1 = Some	ntimes	1=2	-3 mph	2 = 4-5 mph	mph
High Flow Low Flow Low Flow High Flow Low Flow			Down	punoc			Upbou	pu		T		No		2 = often	3 = Alw	ays	3 = 6-	7 mph	4 = 8-10 mph	0 mph
Proof Proof Proof Proof Proof Proof Proof Modelium Low Proof Pro		High	Flow	Low	Flow	High	Flow	Low FI	WO		Flow		Higi	Flow	Γo	w Flow	High	Flow	Low Flow	Flow
44 4 43 48 47 38 36 41 47 18 16 15 13 12 24 17 19 43 34 4 50 27 23 26 42 29 27 13 19 15 15 15 15 15 15 15 15 15 15 15 15 15	BEND	-	Post	Pre	Post	-	Post	Pre		High	Medium	Low	Pre	Post	Pre	Post	Pre	Post	Pre	Post
2.4 2.4 2.4 2.4 2.4 2.4 2.4 2.4 2.4 2.4	-	,	6	0.4	1	0	e e	*	,	9	4	El V	,		č		4	9	Č	,
12 12 13 14 15 15 15 15 15 15 15		r t	? !	G 4	-) e (9 6	0 0	- ·	- (<u>.</u>	0 1	n (3 ;	7.	B-7		20. (0 1	3 (- :
45	Eliza	2.4	7.4	2.9	2.7	2.3	97	2.4	OD PN	2.0	2.0	9.	0.1	0.1	0.3	0.1	6 9	9.	50	6 9
4.5 4.6 5.4 5.4 5.4 5.4 5.4 5.4 5.4 5.4 5.4 5.4	Scudders	4.3	3.4	5.0	3.9	3.3	3.4	3.9	4.3	1.7	9.	5.	- -	0.7	- 80	4.3	,	,	2.0	1.9
42 34 34 34 34 34 34 34	Dogtooth	4.5	4.4	5,4	4.9	3.5	3.6	4.2	4.51	ri.	4.4	1.4	1.0	0.5	9.	-	1.7	4.	ئ ون	1.6
10	Price's Landing	4.2	හ. න	4.7	4.1	3.8	3.55	4.0	3.1	9.	1.8	8.	0.7	0.4	Ç.	0.7	1.9	8,	E .	6
A	Cape Bend	3.5	3.4	3.9	3,7	5.9	2.7	3.7	3.1	6.	1.9	1.9	0.7	0.3	1.3	0.8	<u>1</u>	80	8.	1.9
10	Cape Rock	4.1	4.3	4.7	9.4	3.6	3.0	4.1	3.7	<u>(C)</u>	10	10.	9.0	0.5	1.6	8.0	1.7	89;	89.	1.9
42 42 48 48 48 33 44 33 41 38 148 145 16 0.8 0.8 17 0.9 18 18 42 32 48 44 35 34 38 32 18 18 17 02 0.7 18 0.9 20 42 42 3.7 44 3.8 3.8 3.8 3.8 3.8 18 18 17 0.2 0.0 0.7 18 0.9 0.5 18 0.5 18	Picayune	3.0	2.9	3.4	3.0	2.8	2.7	3.1	2.3	2.0	1.9	6.	0.0	0.0	0.1	0.0	2.0	8.	2.0	1.9
4.8 3.2 6.1 4.0 4.3 3.1 4.8 3.2 1.8 1.7 1.7 1.0 0.7 1.9 1.0 20 4.2 3.7 4.4 3.8 3.3 3.4 4.8 3.3 1.9 1.9 1.9 1.9 0.5 1.9 0.5 1.9 0.9 2.0 4.2 3.7 4.4 3.8 3.3 3.4 4.8 3.3 1.9 1.9 1.9 1.9 0.9 0.5 1.9 0.9 2.0 4.2 3.7 4.4 3.8 3.3 3.4 4.2 1.9 1.9 1.9 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	Fountain Bluff	4.2	4.2	4.8	8.8	3.4	3.3	4.1	3.8	1	ń.	1.6	0.9	0.B	1.7	6.0	1.8	1.7	1.7	1.8
A	Red Rock	37 37	3.2	6.	0.4	4.3	3.1	4. 10.	3.2	1.8	1.7	1.7	1:0	0.7	1.9	1.0	2.0	1.8	£.	6.
A	Kaskaskias	4.2	3.8	4.8	4.4	3.5	3.4	3.8	3.3	2.9	6 .	1.8	6.0	0.5	1,6	6.0	2.0	7.	1.8	1.8
3.9 3.5 4.5 4.4 3.2 3.4 3.8 4.3 1.9 1.9 1.9 0.0 0.1 0.2 0.2 0.2 1.5 1.4 1.2 1.4 1.2 1.4 1.2 1.4 1.2 1.4 1.2 1.3 1.5 1.4 1.2 1.2 <td>St. Geneviava</td> <td>4.2</td> <td>3.7</td> <td>4.4</td> <td>60 00</td> <td>3.3</td> <td>33</td> <td>3.4</td> <td>roj EN</td> <td>80.</td> <td>6.</td> <td>1.7</td> <td>0.2</td> <td>0.0</td> <td>0.8</td> <td>0.1</td> <td>2,1</td> <td>-</td> <td>2.0</td> <td>6.</td>	St. Geneviava	4.2	3.7	4.4	60 00	3.3	33	3.4	roj EN	80.	6 .	1.7	0.2	0.0	0.8	0.1	2,1	-	2.0	6.
1.5 2.5 2.8 3.1 2.1 2.8 3.4 2.3 1.9 1.9 1.8 1.8 0.1 0.1 0.1 0.1 0.1 2.5 2.1 2.2 2.2 2.8 2.9 2.9 1.8 1.8 0.1 0.1 0.1 0.1 0.1 3.4 4.8 5.4 4.2 5.2 5.9 1.5 1.4 1.2 1.3 1.2 2.4 2.0 1.6 4.6 5.0 5.6 6.2 4.4 4.2 5.2 5.9 1.5 1.4 1.2 1.3 1.2 2.4 2.0 1.6 4.6 5.0 5.6 6.2 4.4 4.2 5.2 5.9 1.5 1.4 1.2 1.3 1.2 2.4 2.0 1.6 4.6 5.0 5.6 6.2 4.4 4.2 5.2 5.9 1.5 1.4 1.2 1.3 1.2 2.4 2.0 1.6 4.6 5.0 6.0 0.3 0.0 0.0 5.4 4.18 5.4 5.4 5.2 5.9 1.5 1.4 1.2 1.3 1.2 2.4 2.0 1.6 5.4 4.18 5.4 5.4 5.2 5.9 1.5 1.4 1.2 1.3 1.2 2.4 2.0 1.6 6.0 0.0 0.3 0.0 0.0 0.0 6.0 0.0 0.3 0.0 0.0 6.0 0.0 0.1 0.2 0.0 6.0 0.0 0.0 0.0 6.0 0.0 0.0 0.0 6.0 0.0 0.0 0.0 6.0 0.0 0.0 0.0 6.0 0.0 0.0 0.0 7.1 0.0 0.0 0.0 7.2 0.1 0.1 0.1 8.4 0.1 0.2 0.2 0.0 8.5 0.2 0.0 8.6 0.1 0.0 8.7 0.0 0.0 8.8 0.0 0.0 9.8 0.0 0.0 9.9 0.0 0.0 9.0	Ft. Chartres	3,9	3.5	4.5	4,4	3.2	3.4	80 80 80	4.3	Đ.	in.	4.4	0.9	9.0	6 0,	1.0	6.	1.8	1.8	6
1.5	Carl Baer	33	5.9	3,8	3,1	3.1	2.8	3.4	en esi	6.	6.	87	0.1	0.1	0.1	0.1	6.	6,	ci	6.
High Flow Low Flow Low Flow High Flow Low Fl	Bellarive	2.5	2.1	رب ش	2.2	2.2	2.2	2.6	2.2	8.	B :	89.	0.1	0.1	0.2	0.1	8.	1.8	6	2.0
High Flow Low Flow High Flow Hi	Mosenthein	5,4	100	5.4	5,4	3.8	3.6	3.9	3.7	9,	9.	9.	0.1	0.1	0.1	0.1	£.	¥,	1.7	1.6
Downbound Upbound Low Flow Low Flow High Flow Log O.3 O.	Víctoria	4.6	5.0	5.6	6.2	4.4	4.2		6.9	1.5	4.4	1.2	1.3	1.2	2.4	2.0	1.6	1,5	1.7	1.5
High Flow Low Flow High Flow Log -0.3 -0.4<					mprover	nent								Impro	wernent			Impro	Improvement	
High Flow Low Flow Low Low Low Low Low Low Low Low L	SENO		Down	ponuo			Upbo	pu												
0.1 0.1 0.2 -0.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0		High	Flow	Low	Flow	High	Flow	Low F					Hig	Flow	L	w Flow	High	Flow	Low Flow	Flow
0.0 0.3 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	Greenfield	ò	4	C	~	C	0	ç								α	ç	~	9	8
0.9 1.1 0.0 0.0 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	E S	ď			. 60	5	. 60	90								0.00	i q	- N	9	
0.2 0.5 -0.1 -0.2 0.5 0.4 0.4 0.3 0.9 0.9 0.3 0.6 0.0 0.3 0.3 0.6 0.4 0.5 0.1 0.3 0.4 0.7 0.0 0.8 0.0 0.0 0.2 0.3 0.8 0.9 0.4 0.1 1.6 0.2 0.6 0.0 0.1 0.4 0.1 0.2 0.4 0.3 0.6 0.0 0.0 0.4 0.1 0.2 0.6 0.0 0.0 0.0 0.0 0.4 0.0 0.2 0.6 0.0 0.0 0.0 0.0 0.4 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0	Scudders	ő		· •	_	Ö	0	-0.4						9.0		, O	0	. 01	9	· -
0.4 0.8 0.3 0.9 0.3 0.5 0.0 0.3 0.3 0.6 0.4 0.5 0.6 0.1 0.3 0.4 0.7 0.0 0.0 0.0 0.0 0.0 0.0 0.3 0.4 0.5 0.8 0.4 0.4 0.2 0.4 0.5 0.6 0.6 0.4 0.1 -0.6 0.8 0.2 0.5 0.6 0.4 0.1 -0.2 -0.6 0.0 0.0 0.0 0.4 0.1 -0.2 -0.6 0.0 0.0 0.0 0.4 0.9 0.1 0.5 0.0 0.0 0.0 0.4 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0	Dogtooth	0	اح	Ö	so.	q	*	-0.2						0.5		0.4	ợ	4	Q	0.5
0.0 0.3 0.3 0.6 0.4 0.5 -0.2 0.1 0.3 0.4 0.7 0.0 0.1 0.4 0.7 0.0 0.0 0.0 0.0 0.3 0.3 0.3 1.6 2.1 1.1 1.6 0.3 0.8 0.4 0.2 0.4 0.2 0.6 0.4 0.1 0.0 0.8 0.3 0.0 0.4 0.8 0.1 0.0 0.0 0.4 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Price's Landing	ċ	4	o	10	Ö	en	0.9						0.3		0.5	Q.	-	Ö	0.0
-0.2 0.1 0.3 0.4 0.2 0.8 0.1 0.4 0.7 0.0 0.0 0.1 0.0 0.0 0.2 0.3 0.8 0.4 0.2 0.4 0.5 0.6 0.4 0.1 0.6 0.0 0.6 0.4 0.1 0.0 0.8 0.3 0.0 0.4 0.0 0.3 1.1 0.6 0.0 0.4 0.0 0.1 0.5 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Cape Bend	õ		o	3	o	က	9.0						0.4		0.5	٠	4	0.1	-
0.1 0.4 0.7 0.0 0.0 0.0 0.1 0.7 0.3 0.0 1.6 2.1 1.1 1.6 0.3 0.8 0.4 0.2 0.8 0.5 0.5 0.6 0.0 0.4 0.1 0.5 0.4 0.0 0.1 0.5 0.5 0.0 0.0 0.0	Cape Rock	ợ	2	Ö	<u> </u>	o	m	4.0						0.2		0.8	Ö	_	0.1	-
0.0 0.0 0.3 0.8 0.8 0.8 0.9 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Picayune	o :		0	4	ci (- 1	0.7						0.0		0.1	ợ	~	0.	₩.
1.6 2.1 1.1 1.6 0.3 0.3 0.9 0.4 0.4 0.2 0.4 0.8 0.5 0.6 0.5 0.6 0.5 0.6 0.5 0.6 0.5 0.6 0.5 0.6 0.5 0.6 0.7 0.8 0.8 0.8 0.8 0.0 0.0 0.0 0.0 0.0 0.0	Fountain Bluff	ō.	0 '	o ·	0	o ,	7	0.3						0.3		0.8	Ġ.		0.1	_
0.4 0.2 0.4 0.5 0.6 0.5 0.6 0.5 0.6 0.5 0.6 0.5 0.6 0.5 0.6 0.6 0.6 0.6 0.7 0.6 0.6 0.6 0.7 0.6 0.6 0.7 0.6 0.6 0.7 0.6 0.7 0.6 0.7 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7	Red Rock	- (۰ م	- 73			- (1.6						0.3		6.0	q'	2	0.	τ.
0.5 0.6 0.0 0.8 0.3 0.8 0.8 0.8 0.8 0.9 0.0 0.0 0.8 0.8 0.8 0.9 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Kaskaskias	o c	4 1	0 1	₹ (တ်ဖ	2 0	4.0						5.5		0.6	Q ·	2	0.0	٥,
0.4 0.1 -0.2 -0.6 0.3 0.8 0.3 0.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	St. Genevieve	<u> </u>	ο.	φ (. ب	oi •	o (8.0						0.2	•	0.5	ợ —	N	Ç,	-
0.4 0.0 0.1 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Ft. Chartres	òi	4 .	o (<u>س</u> ۱	9 6	Ņ,	9.0						0.3		0.8	ợ,	-	0.2	Vi -
0.5 0.0 0.2 0.0 0.0	Carl Baer	3 6	4 4	O 1	2 0 (5 6	, to	1.1						0.0		0.0	ę,	m .	-0.2	N,
00 00 00 00 00 00 00 00 00 00 00 00 00	Bellerive	s c	4 14		> 0	j c	- 0	0.0	·					0.0		0.1	0 0	۰,	0.2	NF 1
0.4	Wichoria	6.0	, -	9 9	, a	o c	4 6	5 C						0.0		0.0	o c	- 0	Ģ Ç	ر ب د

Cheenfeld Bend River Cheened	Avg 37.2							Pre-Construction	ruction	Post-Con	Post-Construction
River	37.2	10th Percentile Max	E	Weir	Length	Dist. To	Weir Angla	Max	Weir Height	Max Depth (Ft)	Weir Height
Date Completed		_		1_	617	663	L	35.8		31.8	18.8
Project Extent (River Miles) 3.1 - 3.0 Project Extent (River Miles) 278.8 Nav. Problems Reported 283.8 Project Extent (River Miles) 27.4 8.7 LWRP (NGVD) 280.5 Nav. Problems Reported 285.5 Nav. Problems Reported 285.5 Nav. Problems Reported 27.4 8.7 Nav. Problems Reported 285.5 Nav. Problems Reported 27.1 9 Nav. Problems Report				~	677	288	8 8	8 8	21.8	16.8	4 0.
LVMPP (NGVD) 278.8 Nav. Problems Reported Yes Nav. Problems Reported Yes Nav. Problems Reported Nav. Prob				o ∢	8 2	25.53	2 %	36.8	20.00	15.8 8 8	2.8
Nev. Problems Reported Ves	_			147	969	797	2 2	38.8	23.8	90.00	8 9
Weir Top Elevation 283.8 53 530 900 52.0 River: Date Completed Dec-95 57 - 8.7 1.0	_			6	551	743		37.8	22.8	59.8	4
Project Extent (River Mises				~	578		\$	8.04	25.8	22.8	7.8
Naver Completed	36.9	27.3 65.9	9 20.3	L	559	247	61	37.5	22.5	25.5	10.5
Date Completed Dec-95				8	529	320	22	39.5	24.5	37.5	22.5
Project Extent (River Miles) 5,7 - 8,7			_	ဗ	285	670	77	53.6	38.5	45.5	30.5
Nav. Problems Reported 285.5 Weir Top Elevation 285.5 Weir Top Elevation 285.5 Weir Top Elevation 285.5 Project Extent (River Miles) 10.5 286.9 No. Problems Reported No. Weir Top Elevation 271.9 No. Problems Reported No. Weir Top Elevation 274.2 24.2			_	*	755	900	70	37.5	22.5	35.5	20.5
Nav. Problems Reported No Weir Top Elevation 265.5 Nav. Problems Reported No Date Completed Date-95 Project Extent (River Miles) 16.7 - 17.3 LWRP (MSV) 286.9 No Weir Top Elevation 271.9 Nav. Problems Reported No Date-Completed Date-90 Project Extent (River Miles) 22.4 - 24.2 LWRP (MSV) 280.7 Nav. Problems Reported No Weir Top Elevation 275.7 Nav. Problems Reported No No Weir Top Elevation 275.7 Nav. Problems Reported No No No No Date-Date Extent (River: Miss) 22.4 - 24.2 LWRP (MSV) 280.7 Nav. Problems Reported No	_			ND	724	657	29	58.5	43.5	28.5	13.5
Nav. Problems Reported Niss Nis				9	530	880	99	51.5	36.5	46.5	31.5
River	_			7	533	357	65	37.5	22.5	26.5	11.5
River		_		60	533		8	35.5	20.5	18.5	3.5
River	38.3	26.9 64.9	20.1	-	439	295	99	29.9	6.4		
Date Completed Dac-95		_		N	435	368	8	27.9	12.9		
Project Extent (River Miles) 16.7 - 17.3 Nav. Problems Reported Weir Top Elevation 271.9 Nav. Problems Reported Miss 220.5 Date Completed Dec-90 Dec-90 Project Extent (River Miles) 22.4 - 24.2 Liver Problems Reported No Weir Top Elevation 275.7 Date Completed Miss Date Completed No Nov-91 Project Extent (River Miles) 20.6 - 30.6 Project Extent (River Miles) 20.6 - 30.				en	584	352	SS	97.9	39.9		
LVMPP (NGVD) 286.9 New Problems Reported No New Problems Reported No New Problems Reported Niss 108 6400 520 50.8		_	_	4	450	276	S	49.9	9,		
New Problems Reported				so.	445	266	45	68.8	53.9	Alas Atminstra	al deli
New Top Elevation 271.9 S400 52.0 50.8				80	447	274	\$	83.9	48.9		2
River. Miss 108 6400 520 50.8				_	446	338	5	9,	39.9		
River:	_			00 (£ 5	421	2 :	43.6	28.9		
Niss 108 6400 520 50.8				» £	200	430	5 15	B 000	20.5		
Niss Date Completed Dec-90	35.9	26.6 64.2	20.0	ŀ	128	1252	57			20.7	5.7
Date Completed Dec-90				7	559	1487	85			36.7	20.7
Project Extent (River Mises) 22.4 - 24.2 Project Extent (River Mises) 22.4 - 24.2 Nav. Problems Reported No. On the No.				6	555	1507	75			49.7	34.7
LWRP (NGVD)	_			*	296	687	2			51.7	38.7
Weir Top Elevation 275.7 Weir Top Elevation 275.7 River: Mise 68 5500 620 51.1 Protect Extent (River Mise Nov-91				10 c	912	728	88			69.7	54.7
River: Miss 68 5500 620 51.1 Date Completed Nov-91 Protect Extent (River Miss 3.0 ft	_	_		0 1	8	800	3 :		-	50.7	35.7
River: Miss 68 5500 620 51.1 Date Completed Nov-81 Protect Extent (River Miss) 29.6 - 30.6				- 0	£ 5	/32	3 2	NOT AVBIGDIE	apie	7.4	29.7
River: Miss 68 5500 620 51.1 Date Completed Nov-81 Protect Extent (River) 29.6 - 30.6				0 0	9 6	988	8 8			7.70	27.7
River: Miss 68 5500 620 51.1 Date Completed Nov-91 Protect Extent (River) 29.6 - 30.6				0	222	288	5 8			38.7	24.7
River: Miss 68 5500 620 51.1 Date Completed Nov-91 Protect Extent (River 20 6 - 3.0 6				1	884	609	19			24.7	18.7
Miss 5500 620 51.1 Miss Date Completed Nov-91 Protect Extent (Stiver Miss) 29.6 30.6				12	748	1355	3			28.7	11.7
Miss 5500 620 51.1 Miss Date Completed Nov-91 Protect Extent (Stiver Misses) 29.6 30.6				13	200		2			24.7	8.7
River: Miss Date Content Nov-81 Ionulae Fxtert (Rivere Miles) 29.6 - 30.6	38.2 27	27.0 , 84.2	20.6	-	1077	440	2	39.0	24.0	31.0	16.0
Date Completed Nov-91 Proled Extent (River Mises 29.8.30 6				7	1103	678	3	45.0	30.0	52.0	37.0
Probad Extent (River Miles 129 6 - 30 6)	_		_	6	1216	418	28	49.0	34.0	28.0	11.0
				7	1088	638	67	33.0	18.0	23.0	8.0
TANKE (NGAD)			_	in i	1063	628	3	43.0	28.0	45.0	30.0
Mari Ton Flavation 270				9 1	1116	583	25 25	47.0	35.0	58.0	43.0
_				. «	2 6	040	8 2	0.00	0 0	2 6	43.0
				0	918	3	3 %	40.0	25.0	20.00	17.0

Project					Min Channel	Wase	Cepu	water Depth Over Weir (π)	9	7				Pre-Construction	uction		
			Bend Angle Bend Radius (Degrees) (Ft)	Jend Radius (Ft)	Width (Ft) -10 ft Contour	90th Percentife	Avg P	10th Percentile 1	Max #	 E	Weir Lengi No. (Ft)	Length Dist. To (Ft) Next Weir (Ft	Weir Angle	Max Depth (Ft) Weir Height (Below LWRP) (Ft)	Weir Heighl (Ft)	Max Depth (Ft) (Below LWRP)	Weir Height (Ft)
Cape Bend			107	2600	640		_	_		17.4	H			30.0	15.0	26.0	
	River:	Miss						*******			2 6	409 459	23	39.0	24.0	28.0	*
	Project Extent (River Miles) 48.3 - 49.5	Mai-23											8 8	30.0	15.0	40.0	- 6
	LWRP (NGVD)	308											9	30.0	15.0	22.0	_
	Nav. Problems Reported	ž						***************************************					63	34.0	19.0	24.0	Q)
	Weir Top Elevation	293					_			_		_	95	36.0	21.0	23.0	ω
									_	_			25	30.0	15.0	24.0	9
										_		_	67	28.0	13.0	23.0	
									_				9	22.0	30.0 0.0	10.0 10.0	
													ž ć	21.0	9 0	3.0	
													2	22.0	0.0	25.0	10.0
Cape Rock (Upper)			81	4600	740	46.8	32.1	23.5	59.2	17.4	H		7	24.5	9,5	48.5	8
:	River	Miss		-						_		_	67	29.5	14.5	37.5	71
	Date Completed	Feb-92							_	_	30	11 401	22	24.5	9,5	37.5	22.5
	Project Extent (River Miles) 54.6 - 54.9	4.6 - 54.9		*******								53	20	24.5	9.5	29.5	7-
	Nav. Problems Reported	£ 8															
Cana Book / Journal	vveir 1 op Elevadon	C.082	4.7	6300	OVB	48.8	100	22.6	50.2	17.41	-	1	Ş	101	ţ	43.4	ſ
(FOME)	Date Completed	Feb-92	F	200	2					1	_	782 422	5 5	24.1	9,1	53.	38.1
	Project Extent (River Miles) 53.8 - 54.1	3.8 - 54.1							_		3		\$	19.1	4.1	50.1	m
	LWRP (NGVD)	311.1									_	61	108	24.1	9.1	51.1	ಣ
	Nav. Problems Reported Weir Top Elevation	296.1							_								
Picayune			78	10500	720	46.4	31.8	23.2	58.7	17.2	┢		57	25.7	10.7	33.7	F
	River	Miss				٠		*********			2	296 620	\$	22.7	7.7	33.7	18.7
	Date Completed F60-50	160-53									_		50	31.7	16.7	286.7	N e
	Project Extent (River Mines) of	249 7									_		ò °	20.5	7.87	30.7	2 6
	Nav Problems Renorted	i 2	-							_	_	_	3 &	43.7	28.7	7.00	ý ř.
	Weir Top Elevation	297.7						,,					20	35.7	20.7	33.7	5 4=
													28	35.7	20.7	33.7	-
													20	39.7	24.7	33.7	7
												_	92	31.7	16.7	46.7	Ġ
													99	28.7	13.7	23.7	-
													25 65	28.7	13.7	24.7	
													8 2	26.7	17.7	28.7	~ -
Fountain Bluff		I	86	6400	700	47.3	32.8	24.8	58.7	19.3	t	Ļ	61	34.0	19.0	28.0	14.0
	River	Miss									2	567 550	19	37.0	22.0	56.0	41.0
	Date Completed	Jan-96											29	42.0	27.0	29.0	14.0
	Project Extent (River Miles) 83.0 - 84.1	33.0 - 84.1											89	33.0	18.0	31.0	16.0
	LWRP (NGVD)	326									_		69	53.0	38.0	38.0	23.0
	Nav. Problems Reported	2 5									_		88	52.0	37.0	53.0	en c
	ven rop mevanor	-											3 8	41.0	20.00	0.00	, ,
													7	43.0	280	25.0	40.0
								•	•						2.54	2:22	

Project Extent (River Miles)							18/2-0-	Denth	Ourse Mail	- (40)		_				•		
Properties Pro	Project					Min Channel									Pre-Constri	uction	Post-Con	-
Proceeding				end Angle B	Jend Radius	-10 ft Contour	90th Percentile		10th		_	_			(Relow I WRP)	Weir Height	Max Depth (Ft)	
Project Energian Wass Project Energian Proj	Red Rock			88	3800	840	47.8		25.7			 			24.0	9.0	21.0	8.0
Project Enter (Nove Males) 27 - 94 6 Project Enter (Nove Males) P		River: Date Comoleted	Miss Jan-93									2 70		67	39.0	24.0	34.0	19.0
UNIVERPLICATION 331 CHO AND TRANSPORTED BY THE BOOK OF TH			93.7 - 94.8								_			2 29	39.0	24.0	65.0	20.0
Well Top Elevation 116 1		LWRP (NGVD)	331								_			63	34.0	19.0	0.40	49.0
Project Edwir (Nove Males) 10.5 1.5		Weir Too Flevation	318									_	_	2 8	20.00	2.4.0	92.0	27.0
Project Edwarf (Nove Hales) Sociation			!								-		_	75	38.0	24.0	72.0	57.0
Project Enter (Rever Mass)								1			-	-		74	34.0	19.0	53.0	38.0
Date Correlated March Ma	Kaskaskia Bend	-		2	2200	900		32.4	25.0		0.1	_		82	38.1	21.1	30.1	15.1
Project Enerit (New Miles) 16.0 - 117 - 11		Date Completed	Mar. de									_	_	8 8	8 8	5.	20.5	5.5
New Problems Reported Main Sep 27 100			6.0 - 117.1									_		3 %	24.1	, a	24.5	2 0
Main Problems Reported No			344.1					-				-		55	25.1	10.1	22.1	7.7
River: Main 52.1 11.1 34.1 13.1 34.1 13.1 34.1 <		Nav. Problems Reported	o _N										_	98	28.1	13.1	30.1	15.1
Project Enert (Rev Miss Reported New Miss SS 60000 600 45.0 30.0 46.0 31.0 54.0 57.0 56.0 56.0 57.0 57.0 57.0 57.0 57.0 57.0 57.0 57		Weir Top Elevation	329.1	_							_			5	28.1	13.1	34.1	19.1
Project Etherh (River Miles) 18.8 - 170.8 11.00 10.0 46.2 32.0 24.6 55.4 19.9 11.0 55.1 11.1 23.1 23												_	_	48	31.1	16.1	20.1	7.
River								_			_		_	51	28.1	17.7	24.1	<u></u>
River Miss S2 10300 800 46.2 32.0 24.8 56.4 19.9 11 591 371 591 371 591 11.1 23.1 Project Exemple Sap. 57 24.8										_	_		_	5	23.1	4.	24.1	œ.
Project Extend (New Miles) Sep 97 Project Extend (New Miles) Sep 98 Project Extend (New Miles) S	Genevieve		\dagger	62	40900	NAM.	T	200	973			+	4	ត្ត	26.1		23.1	œ.
Project Extent (Nover Miles) 19.8 - 12.08		River	Wiss	ď	3	8		0.56.0				_		8 &	30.6	4.6		
Project Enternt (River Miles) 18.8 - 120.8			Sep-97		_			_			_			2/5	28.4	13.4		
LWRP (NOVD) 386.4 No. Average by the Nove (NOVD) 336.4 No. Average by the Nove (NOVD) 45.0 43.0 55.3 65.4 10.4 Nor Average by the Nove (NOVD) 10.4 Nor Average by the Nove (NOVD) 10.4 Nor Average by the Nove (NOVD) 10.4 Average by the Nove (NOVD) Av		8	19.8 - 120.8									_	_	88	27.4	12.4		
Nav. Problems Reported No		LWRP (NGVD)	346.4	•							_	_		\$	25.4	10.4	Mot Ave	dahle
Project Estration 351-4 174 124		Nav. Problems Reported	9 2									_	_	8	23.4	4		
River		veri 100 Elevation	4.155					_				-		3 3	32.4	4.71		
River Miss 55 6000 600 45.0 30.8 23.8 54.8 19.2 1 554 948 61 25.4 10.4 47.0 Date Completed Apr-64					_						_			8 8	27.7	12.4		
Project Extent (River Miles) 13-6-1 Miss September Apr. Holest Extent (River Miles) 13-7-133 September Apr. Holest Extent (River Miles) 13-7-133 Apr. Holest Extent (River Miles) 13-7-134 Apr. Holest Extent (River Miles) 13-7-134 Apr. Holest Extent (River Miles) 13-7-134 Apr. Holest Extent (River Miles) 13-7-1											_			8 5	25.4	4.05		
Project Extent (River Miles) 28.4 28.6 27.0 27.0 28.6 27.0 28.6 27.0 28.6 27.0 28.6 27.0 27.0 28.6 27.0 27.0 27.0 28.6 27.0 27.0 27.0 28.6 27.0	Fort Chartes			99	8000	800	T	6.0	r			┢	L	81			47.0	32.0
Project Extent (River Miles) 359.9 - 131.0 Apr-94 A		_	Miss							_	_	-		20			28.0	13.0
Project Extent (River Miles) 29.9 - 13.1.0		Date Completed	Apr-94	_										48			27.0	12.0
LVMPP (NGVD) 353		Project Extent (River Miles) 2	9.9 - 131.0				_				_	_		43			63.0	48.0
Nav. Problems Reported Yes 1068 695 58 37.0 Weir Top Elevation 338 4420 7 938 -521 58 18.0 River Miss 34 0700 640 45.0 31.0 24.2 55 16.0 Project Extent (River Miles) 132.7 - 133 Sep-98 36.2 21.2 A4.2 27.2 Not Aveilable LWRP (NGVD) 354.2 3 736 570 74 42.2 27.2 Not Aveilable Nucl. Type Langeborded No No 4 948 570 74 42.2 27.2 Not Aveilable		LWRP (NGVD)	353			*****				_	_			8	Not Availa	eld.	37.0	22.0
Weir Top Elevation 338 Weir Top Elevation 338 45.0 52.1 58 18.0 18.0 River. Miss 34 0700 940 46.0 31.0 24.0 54.8 19.4 1 834 385 68 38.2 21.2 16.0 16.0 Project Extent (River Miles) 12.7 - 133 LWRP (NGVD) 354.2 27.2 Not Available Nat. Top Charm Reported And And And And And And And And And An		Nav. Problems Reported	Yes					-	_		_	_		88			37.0	22.0
River Miss 34 0700 940 45.0 31.0 34.0 54.8 19.4 1242 55 55 16.0		Weir Top Elevation	338								_	7 936	•	28			18.0	1.0
River Miss 34 0700 040 45.0 31.0 24.0 54.8 19.42 50 50 36.2 21.2 16.0								_				_	_	55			16.0	1.0
River Miss 34 0700 940 45.0 31.0 34.0 54.8 19.4 1 834 395 68 36.2 21.2 Date Completed Sep-98 49.2 24.2 27.2 Project Extent (River Miles) 132.7 - 133 354.2 4 948 570 74 42.2 27.2 Nav. Froblems Reported No National Project September No National Project September No National Project September National Project Septe			1				7	+	┪	-		+		20			16.0	1.0
3 736 570 74 42.2 27.2 4 948 67 40.2 25.2	cstablishment	River	Nice	ਲ	00/00	25		0.1			_			28	36.2	21.2		
4 948 67 40.2			Seo-98					-				_		2 6	49.4	24.4	Not Avai	labie
		Project Extent (River Miles) 13	32.7 - 133					_				948		83.2	40.2	25.5		
		LWRP (NGVD)	354.2													!		
		Nav. Problems Reported	2								_	_	_					

TABLE 2 - (Concluded)	(per																
Project					Min Channel	Water	Depth	Water Depth Over Weir (ft)	(E)					Pre-Construction	ruction	Fost-Construction	truction
,		<u> </u>	Bend Angle Band Radlus	and Radlus	Width (Ft)	4106		10th		Š	Weir Length			Max Depth (Ft)	Weir Heigh	Weir Angle Max Depth (Ft) Weir Height Max Depth (Ft)	Weir Height
		Ξ	(Degrees)	(Ft)	tour	2		Percentile	Max	Min	No. (Ft)	Next Weir (Ft		(Below LWRP)		(Below LWRP)	(Ft)
Carl Baer			39	8700	800	45.4	31.5		54.1 2		H	299	61	20.1	5,1	28.1	13.1
	River:	Miss			٠							379	45	45.1	30.1	24.1	9.1
	Date Completed	Sep-96								_		610	89	25.1	10.1	28.1	11.1
	Project Extent (River Miles 163.3 - 164.0	3.3 - 164.0								_		456	71	45.1	30.1	27.1	12.1
	LWRP (NGVD)	370.1									5 658	498	74	25.1	10,1	28.1	13.1
	Nav. Problems Reported Weir Top Elevation	365.1											7.8	35.1	20.1	22.1	7.1
Bellerive			N/A	Straight	460	46.4	32.6	26.5	54.8 2	22.7	┝	671	99	24.7	8.7	23,7	8.7
	River	Miss				***************************************					2 722	680	25	24.7	19.7	24.7	8.7
	Date Completed	Apr-96				*******				***		689	22	24.7	9.7	24.7	9.7
	Project Extent (River Miles) 74.0 - 174.	4.0 - 174.7				•••••			_	_		816	99	24.7	9.7	26.7	11.7
	LWRP (NGVD)	374.7									-		522	24.7	8.7	29.7	14.7
	Nav. Problems Reported	No.															
	weil 100 Elevation	200.	8	77000	77.77		- 0			-	-		(ç		Š
Mosentaein	i		3	11300	046	30.00	7.77	0.0	45.0	13.0		3	20	20.0	28.8	43.8	70. 70. 70.
	_	Miss								_		521	89	48.9	33.9	46.9	31.9
	Date Completed	Apr-97								_	3 652	625	67			47.8	32.8
	Project Extent (River Miles) 93.9 - 195.(3.9 - 195.0					_			_		2404	99	Not Available	ilable	46.9	31.9
	LWRP (NGVD)	395.9					_					696	28			58,9	43.9
	Nav. Problems Reported Weir Top Elevation	Yes 380.8					-						49			46.9	31.9
Victoria Bend			108	4200	1100	52.5	37.5	25.8	63.4 21.9	6.1	1 410	1074	7/8	52.5	32.5	45.5	25.5
		Lower Miss				-,-,-					390	1063	71	49.5	29.5	55.5	35.5
	Date Completed	98		-						_	540	1080	69	54.5	34.5	75.5	56.5
	Project Extent (River Miles 694.9 - 595.6	4.9 - 595.6								_		1150	69	68.5	48.5	75.5	55.5
	LWRP (NGVD)	112.5									681	1263	75	61.5	41.5	85.5	65.5
	May, Problems Reported	7.68 5.55								_			23	68.5	48.5 5	80 80 80 80	10 10 10 10 10 10 10 10 10 10 10 10 10 1
	TOTAL PARTIES.	A design				-	1				-						

3 Bendway Weir Field

Constructed Bendway Weir Systems

Greenfield Bend: (Figure 1) Middle Mississippi, RM 3.1 - 3.9, Completed October, 1995, LWRP 278.8 ft above North Gulf Vertical Datum (NGVD)

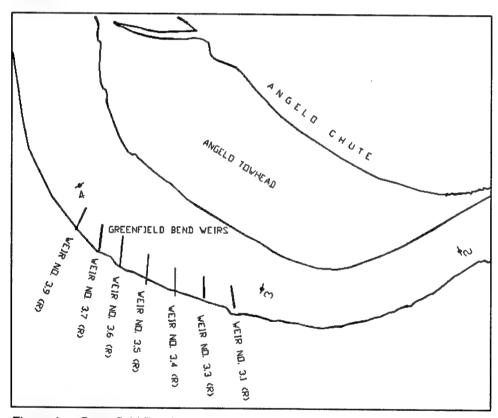


Figure 1. Greenfield Bend

The bend has an approximate angle of 71 degrees and a circular radius of 4600 ft. There are seven bendway weirs in the system with orientation angles of 64 to 76 degrees off the upstream direction. Prior to construction the minimum bottom elevation near the design weir positions ranged from 234 ft to 243 ft NGVD. With the design weir-top elevation of 263.8 ft the weirs were between 20 and 30 ft high immediately after construction. The post-construction survey shows that generally sediment deposition occurred upstream and scour downstream. Based on historical stage records the average depth over the weirs is about 37 ft with a range of 20 ft to 66 ft.

Based on pilot comments, Greenfield Bend was of the more critical areas post-construction. The general comment seemed to be that slow moving tows, i.e., heavy and upbound, tended to be pushed out toward the bar. The average pilot rating for Greenfield after weir construction indicated more difficulty than before in low flow and less difficulty during high flow. The pilot comments were as follows:

- Greenfield, I haven't caught it yet. The only thing I know is my partner told me it turned him every way it could N/B, that was 5/12/98.
- Greenfield Bend is real bad with a slow moving tow. It wants to take you
 out on the bar at a low flow.
- At Greenfield I noticed a hard draft on red buoy upbound with a heavy tow barely kept buoy from going under boat. Downbound at Greenfield current was very swift and drafty. I almost overflanked one time out running red buoys and sand bars.
- N/B in low Cairo gage 15 ft or lower, there is a hard draft angle to towhead MI 3.5.

Eliza Point: (Figure 2) Middle Mississippi, RM 5.7 – 6.7, Completed December, 1995, LWRP 280.5 ft NGVD.

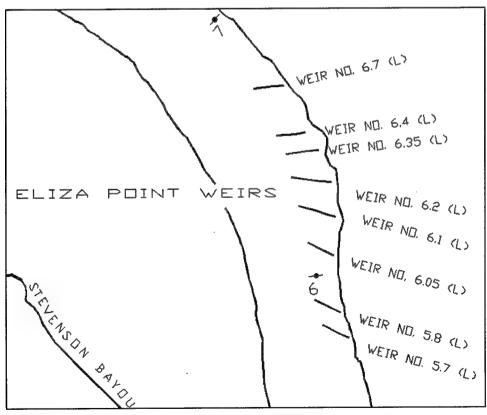


Figure 2. Eliza Point

The bend has an approximate angle of 53 degrees and a circular radius of 5300 ft. There are eight weirs in the system with orientation angles ranging from 61 to 77 degrees from the upstream direction. Prior to construction the minimum bottom elevation near the design weir positions ranged from 222 ft to 245 ft NGVD. With the design weir-top elevation of 265.5 ft the weirs were between 20 and 43 ft high immediately after construction. The post-construction survey shows that generally sediment deposition occurred downstream and scour upstream. The average depth over the weirs is about 37 ft with a range of 20 ft to 66 ft.

The average difficulty rating by the pilots was comparatively low and showed little change post-construction. No comments concerning navigation through Eliza Point bend were received.

Scudder's Landing (Figure 3) Middle Mississippi, RM 16.7 – 17.3, Completed December 1995, LWRP 286.9 ft NGVD.

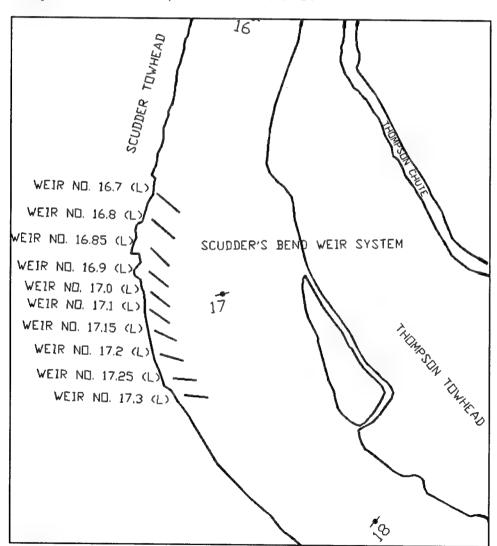


Figure 3. Scudder's Landing

The bend has an approximate angle of 76 degrees and a circular radius of 7500 ft.

There are ten weirs in the system with orientation angles ranging from 42 to 63 degrees from the upstream direction. Prior to construction the minimum bottom elevation near the design weir positions ranged from 218 to 259 ft above NGVD. Since the weir-top elevation was 271.9, the weirs were between 13 and 54 ft high right after construction. No post construction survey was available to determine post construction scour and deposition patterns. The average water depth over the weirs has been about 36 ft with a range of 20 to 65 ft.

Pilot rated difficulty shows post-construction improvement for both high and low flow; however, some disagreement was evident. Pilot comments are as follows:

- Scudders is like Fort Chartres, it grabs the head of the tow and doesn't let go, we have to steer to port to get up through it.
- Cape Rock Price to Daniels and Scudders are much easier since construction.

Dogtooth Bend: (Figure 4) Middle Mississippi, RM 22.4 – 24.2, Completed December 1990, LWRP 290.7 ft NGVD.

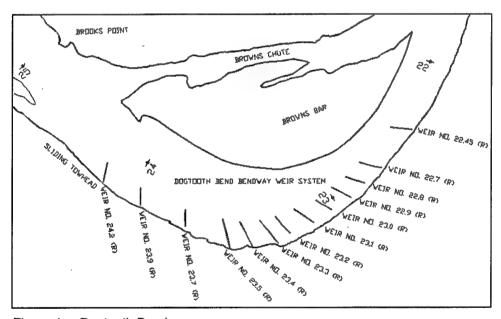


Figure 4. Dogtooth Bend

The bend has an angle of 108 degrees and a circular radius of 6400 ft. There are thirteen weirs in the system with orientation angles ranging from 57 to 75 degrees from the upstream direction. There was no pre-construction survey available; however, the post-construction survey shows that the weir heights ranged from 10 to 55 ft. The average water depth over the weirs was 36 ft and ranged from 21 to 64 ft.

Pilot ratings indicated post-construction improvement in navigation conditions for both high and low flow. Pilot comments were minimal:

Very strong draft on bar.

Price's Landing: (Figure 5) Middle Mississippi, RM 29.6 - 30.6, Completed November 1991, LWRP 294.0 ft NGVD.

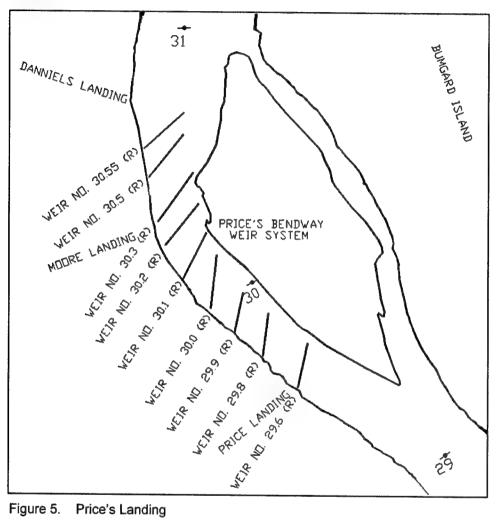


Figure 5. Price's Landing

The bend has an angle of 68 degrees and a circular radius of 5500 ft. There are nine weirs in the system oriented with the upstream direction at angles of 52 to 67 degrees. Prior to construction the minimum bottom elevation near the design weir positions ranged from 242 ft to 261 ft NGVD. With the design weir-top elevation of 279 ft the weirs were between 18 and 37 ft high immediately after construction. The post-construction survey shows that deposition occurred downstream of some of the weirs and scour below others. The average depth over the weirs is about 36 ft with a range of 21 ft to 64 ft.

Pilot ratings show less difficult tow navigation post-construction. Price's Landing was mentioned only once in the pilot comments:

 Cape Bend – Price to Daniels and Scudders are much easier since construction.

Cape Bend: (Figure 6) Middle Mississippi, RM 48.3 – 49.5, Completed March 1995, LWRP 308 ft NGVD.

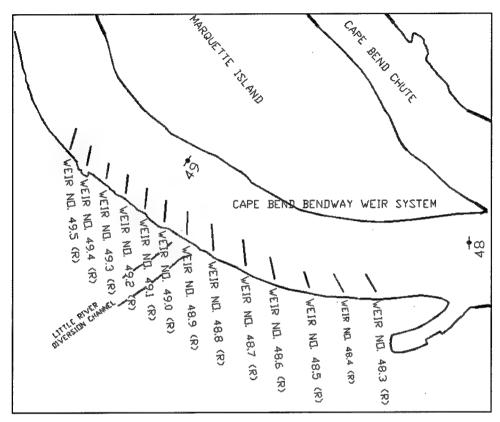


Figure 6. Cape Bend

The bend has an angle of 107 degrees and a circular radius of 7600 ft. There are thirteen weirs in the system oriented with the upstream direction at angles of 53 to 67 degrees. Prior to construction the minimum bottom elevation near the design weir positions ranged from 269 ft to 287 ft NGVD. With the design weir-top elevation of 293 ft the weirs were between 6 and 24 ft high immediately after construction. The post-construction survey shows that generally deposition occurred throughout the weir system. The average depth over the weirs is about 32 ft with a range of 17 ft to 60 ft.

Pilot ratings show less difficult tow navigation post-construction. Cape Bend was mentioned seldom in the pilot comments:

- Cape Bend Price to Daniels and Scudders are much easier since construction.
- Cape Bend Sometimes a little disturbance (very good).

Cape Rock: (Figure 7) Middle Mississippi, RM 53.8 – 54.9, Completed February 1992, LWRP 311.3

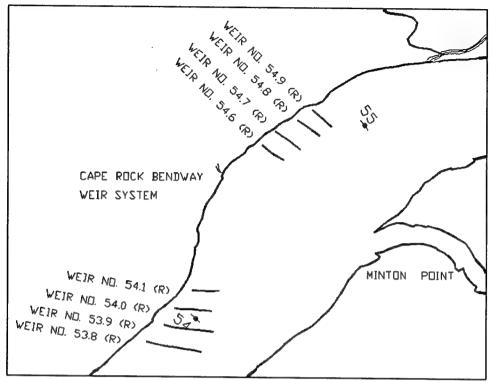


Figure 7. Cape Rock

The weir system is made up of two bends with four weirs in each. The downstream bend has an angle of 47 degrees and the upstream bend is 81 degrees. The circular radii are 6300 and 4600 ft, respectively. The pre-construction minimum bottom elevations ranged from 287 to 292 ft with weir height from 4 ft to 14 ft. The post-construction survey shows deep scour downstream of all the weirs. The average depth over the weirs is about 32 ft with a range of 17 ft to 59 ft.

Pilot ratings indicate an improvement in navigation conditions after construction of the Cape Rock weirs; however, pilot comments conflict:

- Cape Rock still has a large eddy at the foot of the bend and will affect your tow N/B and S/B at most stages.
- Cape Rock a large eddy at the foot of bend bad N/B and S/B.
- Cape Rock was real bad for a while but at this time in low flow it seemed somewhat better. That dike below [?] needs to have about half of it removed.

Picayune (Figure 8) Middle Mississippi, RM 55.8 – 57.8, Completed February 1995, LWRP 312.7 ft NGVD.

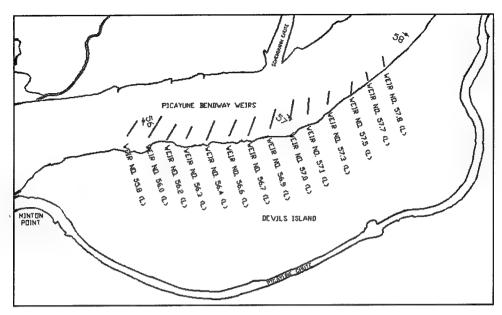


Figure 8. Picayune

The bend angle is approximately 78 degrees with a radius of 10,500 ft. There are fourteen weirs in the system with orientation angles with the upstream direction of 51 to 66 degrees. Minimum pre-construction bottom elevations ranged from 268 ft to 290 ft NGVD giving weir heights between 8 and 30 ft. Post-construction surveys show scour generally upstream and deposition downstream. The average water depth over the weirs is 32 ft with a range of 17 to 59 ft.

Pilot ratings show less difficult tow navigation post-construction. The pilots did not comment specifically on the Picayune Bend.

Fountain Bluff: (Figure 9) Middle Mississippi, RM 83 – 84.1, Completed January 1996, LWRP 326 ft NGVD

The bend angle is about 98 degrees with a radius of 6400 ft. There are ten weirs constructed and are oriented with the upstream direction at between 57 and 71 degrees. Minimum pre-construction bottom elevations ranged from 273 ft to 292 ft and the weirs were anywhere from 18 ft to 38 ft high. A post-construction survey showed some deep scour holes but overall not much change in weir height. The average water depth over the weirs is 33 ft ranging from 19 ft to 59 ft.

Pilot ratings show a general improvement in navigation conditions at Fountain Bluff post-construction. Pilot comments suggest that conditions have slowly improved:

- Fountain Bluff was bad during and several months after, but has settled down and smoothed out over the years.
- Fountain Bluff was bad during and several months after, has settled down over the years.

- Fountain Bluff was critical but has settled down now.
- Strong draft on bar.

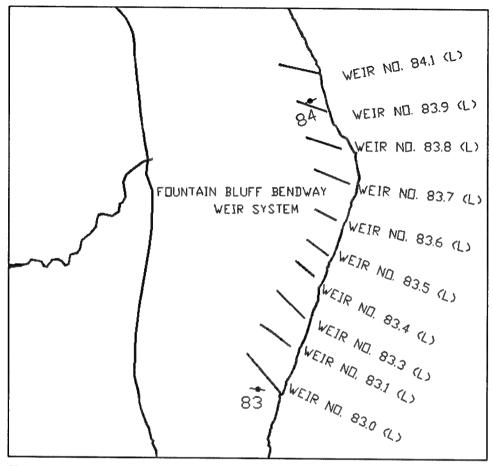


Figure 9. Fountain Bluff

Red Rock: (Figure 10) Middle Mississippi, RM 93.7 – 94.8, Completed January 1993, LWRP 331 NGVD

The bend angle is approximately 88 degrees with a radius of 4200 ft. There are nine weirs in the system, which are oriented with the upstream direction at between 63 and 75 degrees. Minimum pre-construction bottom elevations ranged from 292 ft -307 ft and the weir heights ranged from 9 ft to 24 ft. The post-construction survey indicated a large amount of scour below all the weirs except for the first two upstream. The average water depth on the weirs is 34 ft ranging from 20 ft to 59 ft.

Pilot ratings show a significant improvement in navigation conditions at Red Rock after weir construction. No pilot comments were received for this area.

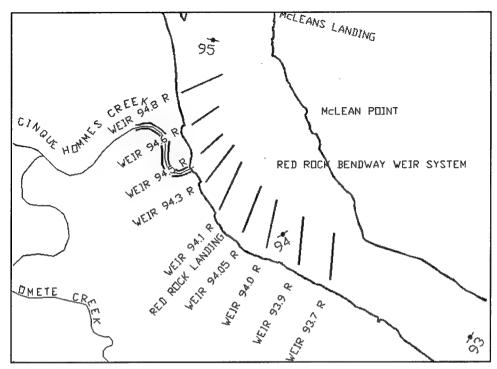


Figure 10. Red Rock

Kaskaskia Bend: (Figure 11) Middle Mississippi, RM 116.0 – 117.1, Completed March 1994, LWRP 344.1 NGVD

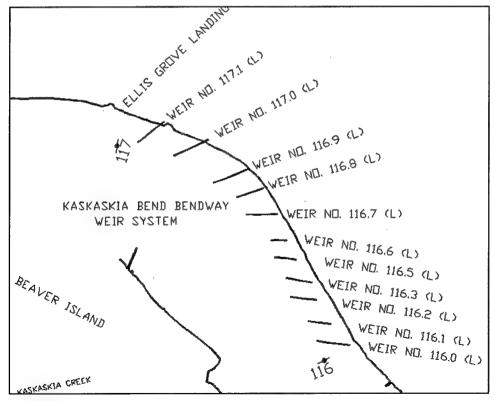


Figure 11. Kaskaskia Bend

The bend angle is approximately 81 degrees with a radius of 5500 ft. There are eleven weirs in the system which are oriented with the upstream direction at between 51 and 69 degrees. Minimum pre-construction bottom elevations ranged from 308 ft to 323 ft and the weir heights ranged from 6 ft to 21 ft. The post-construction survey generally indicated slight scour downstream of the weirs. The average water depth on the weirs is 32 ft ranging from 20 ft to 57 ft.

Pilot ratings show improvement in navigation conditions after weir construction. No pilot comments were directed specifically at Kaskaskia Bend.

St. Genevieve: (Figure 12) Middle Mississippi, RM 119.8 – 120.8, Completed September 1997, LWRP 346.4 ft NGVD.

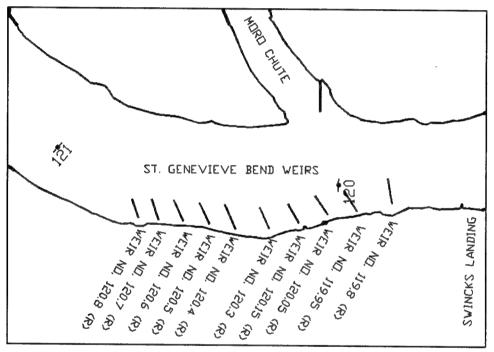


Figure 12. St. Genevieve

The bend angle is 52 degrees with a radius of 10,300 ft. There are ten weirs in the system and they are oriented with the upstream direction at between 56 and 91 degrees. Minimum pre-construction bottom elevations ranged from 314 ft to 323 ft and the weir heights were from 8 ft to 15 ft. No post-construction survey was available for comparative bottom contours. The average water depth over the weirs is 32 ft ranging from 20 ft to 56 ft.

Pilot ratings show improvement in navigation conditions after weir construction.

No pilot comments were directed at the St. Genevieve Bend.

Fort Chartres: (Figure 13) Middle Mississippi, RM 129.9 – 131.0, Completed April 1994, LWRP 353.0 ft NGVD.

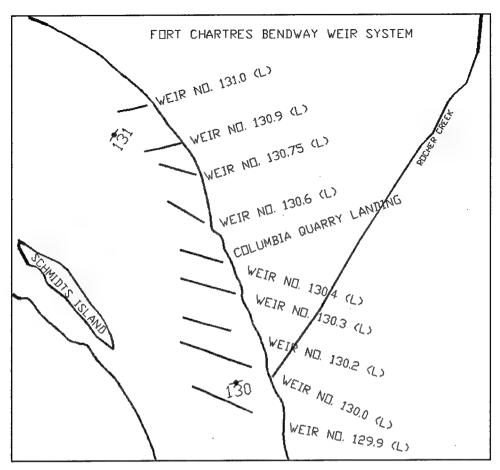


Figure 13. Fort Chartres

The bend angle is 55 degrees and the bend has a radius of 6000 ft. There are nine weirs in the system oriented with the upstream direction between 43 and 70 degrees. There was no pre-construction survey available. The post-construction survey showed significant weir heights toward the middle of the system and low weir heights at the downstream end, this pattern suggests scouring and deposition, respectively. The average water depth over the weirs is 32 ft with a range of 19 ft to 55 ft.

Pilot ratings indicate a degradation of navigation conditions post-construction. This bend is one of the more critical in the Middle Mississippi based on pilot comments:

- Fort Chartres has really been a pain in low flow north and south bound and some in high flow, it pulls the stern out and have to steer down to port to stay off the bank.
- Fort Chartres is also a place to watch real close. No matter how far you
 get in the bend it is going to draft you out to the bar, if moving slow it is
 hell handling your tow.
- Fort Chartres seems to be the worst one going N/B. Where these weirs are seems to narrow the channel above them and widen it below them.

- Personally, I like the weir dikes except the ones at Fort Chartres, if you don't watch it, it will get you N/B.
- At Fort Chartres N/B hard draft behind bar at Crooks St. Louis (Gage) 10 ft or below, S/B a little disturbance at Crooks, minor.
- Fort Chartres has had the worst reactions for me upbound flow wasn't really [reduced]. Pushing a heavy tow N/B up into the bend can be very difficult since construction of weirs.
- The bendway weirs at Ft. Chartres create a difficult condition in low water. The water coming off the weirs is conflicting with the river flow. You have bendway weir water pushing on your starboard stern and river current pushing on your port head. At times the 2 forces easily over come the rudder power of the vessel and make controlling the tow difficult. Similar conditions exist at Victoria Bend LM 594.
- At Fort Chartres very strong draft on bar.
- One of the most severe N/B "SETS" occurs at Fort Chartres during low water. I had a near miss at this location N/B during September 1998 with 20 loads and 4 empties on the 6200 HP Larry Y. Strain. I was favoring the center of the channel watching for the set to the buoys on the lower side of the turn. As I approached the middle of the bend (the turn buoy at the upper end of the weir field), the current coming down above the weirs caught the head of the tow causing it to swing to the left descending bank. I was steering hard down to the port and the tow was still swinging hard to the starboard. I was just about to call LEROY (cause he ain't never seen a wreck like we're fixin to have) when I finally got the swing to the bank to stop. The boat still would not swing the tow to the port with the rudders hard over to the port. The tow stalled out and started to drift back down the river - rudders still hard down to port. As it drifted back it was setting out toward the buoys where the water was slacker. It had drifted back about 1200 feet when it finally started to move ahead and steer around to the port. Looking back now, I was fortunate to have approached the bend as I did. If I had been closer to the buoys coming into the bend, the tow would have stalled and set out on the sandbar behind the buoys.

Establishment: (Figure 14) Middle Mississippi, RM 132.7 – 133.0, Completed September 1998, LWRP 354.2 ft NGVD

This weir system is located in a bend with an angle of 34 degrees and a radius of 9700 ft. There are four weirs in the system oriented with the upstream direction at 67 to 74 degrees. The pre-construction hydrographic survey shows bottom elevations ranging from 335 ft to 342 ft with weir heights from 21 ft to 34 ft. No post-construction survey was available. The average water depth over the weirs is 31 ft with a range of 19 ft to 55 ft.

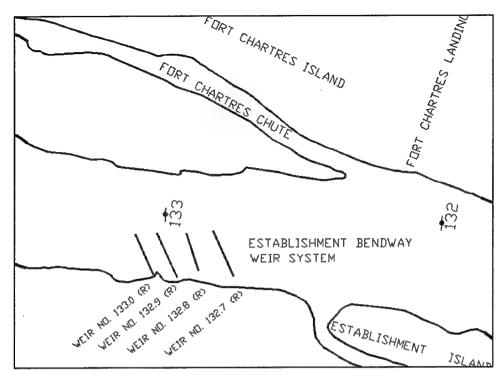


Figure 14. Establishment

Pilot comments and ratings were not collected for this bendway system. These weirs are the latest ones built and, as such, pilots have not formed an opinion yet concerning the navigation impacts.

Carl Baer: (Figure 15) Middle Mississippi, RM 163.3 – 164.0, Completed September 1996, LWRP 370.1 ft NGVD.

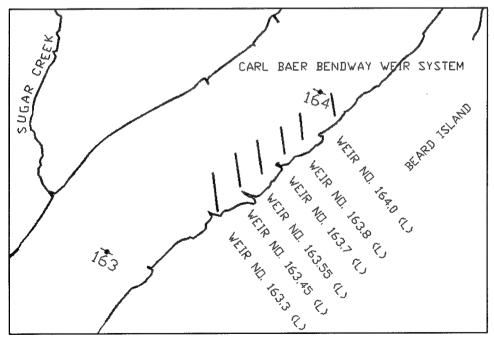


Figure 15. Carl Baer

The bend angle is approximately 39 degrees with a bend radius of 8700 ft. There are six weirs in the system oriented upstream at 61 to 78 degrees. The preconstruction hydrographic survey shows bottom elevations ranging from 325 ft to 350 ft with weir heights from 5 ft to 30 ft. The post-construction survey shows generally more deposition than scouring with weir height ranging from 7 ft to 13 ft. The average water depth over the weirs is 32 ft with a range of 21 ft to 54 ft.

Pilot ratings show an improvement in navigation conditions after weir construction. No pilot comments were received concerning navigation through this bend.

Bellerive: (Figure 16) Middle Mississippi, RM 174.0 – 174.7, Completed April 1996, LWRP 374.7 ft NGVD

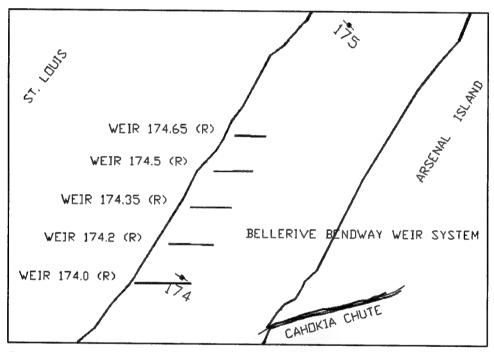


Figure 16. Bellerive

This weir system was constructed in a straight reach past St. Louis. There are five weirs in the system oriented with the upstream direction at 54 to 56 degrees. The pre-construction hydrographic survey shows bottom elevations ranging from 340 ft to 350 ft with weir heights from 8 ft to 15 ft. The post-construction survey shows generally little change in bottom conditions with some scour evident near the downstream weirs. The average water depth over the weirs is 33 ft with a range of 23 ft to 55 ft.

Pilot ratings show an improvement in navigation conditions after weir construction. No pilot comments were received concerning navigation through this reach.

Mosenthein/Chain of Rocks Canal: (Figure 17) Middle Mississippi, RM 193.9 – 195.0, Completed April 1997, LWRP 395.9 ft NGVD.

This weir system consists of six weirs split into two groups with four weirs above the mouth of the Chain of Rocks Canal and two below. The bend is gentle with a heading change of 33 degrees and a radius of 11,300 ft. The weirs are oriented with the upstream direction at 57 to 68 degrees. Only a partial preconstruction hydrographic survey was available which shows bottom elevations around 350 ft with weir heights 30 ft. The post-construction survey shows weir heights ranging from 29 to 44 ft. The average water depth over the weirs is 25 ft with a range of 18 ft to 42 ft.

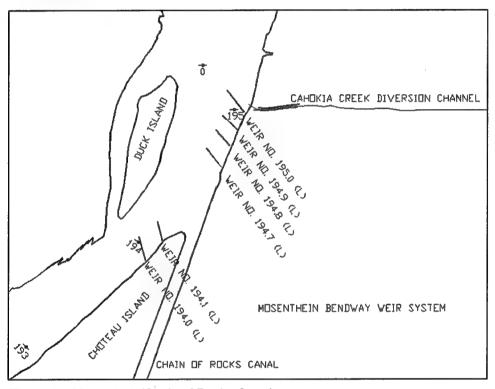


Figure 17 Mosenthein/Chain of Rocks Canal

Pilot ratings show an improvement in navigation conditions after weir construction; however, this conflicts strongly with the comments received:

- The weir above Chain of Rocks Canal is going to cause someone to sink some time. That has caused an extreme draft to the head of the island and you have to shove the left bank downbound.
- Chain of Rocks Canal. The head is becoming a nightmare. For years you
 try to miss Continental Oil dock, now you better try and hit it, if not you
 will hit the head of the island, the higher the water the worse its is.
- The Mosenthein weirs should never have been put in. Post construction causes you to hold out more off [?] dock which makes it extremely hard.
 To get tow back closer to shore to make it in mouth of Chain of Rocks

Canal. At times have had to push harder which puts head loads in danger of going under when they hit slack water at mouth. Also head of tow in toward bank turns stem out.

• The Mosenthein has made the entrance to the Chain of Rocks Canal a little more tricky than what it used to be. The draft is very hard pulling you away from the entrance the higher the flow the worse it gets.

Victoria Bend; (Figure 18) Lower Mississippi, RM 594.9 – 595.6, Constructed 1995, LWRP 112.5 ft NGVD

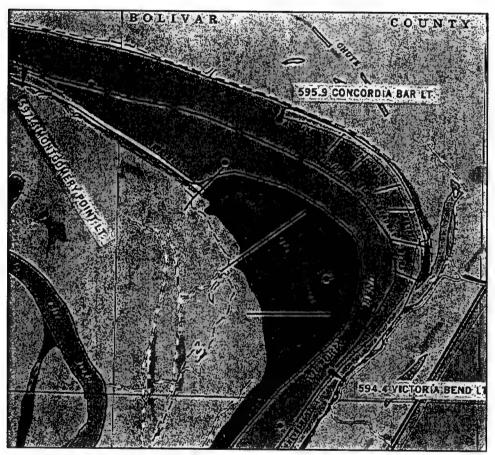


Figure 18. Victory Bend

This weir system consists of six weirs oriented with the upstream direction at 69 to 76 degrees. The bend has a heading change of 108 degrees and a radius of 4200 ft. The pre-construction hydrographic survey shows bottom elevations ranging from 44 ft to 60 ft with weir heights from 24 ft to 43 ft. The post-construction survey shows deposition at the upstream weir and scouring throughout the remainder of the system. The average water depth over the weirs is 37 ft with a range of 22 ft to 63 ft.

Pilot ratings show a degradation of navigation conditions post-construction. The pilots had some harsh comments concerning this bend:

- Victoria Bend Tow handling is erratic S/B and N/B at all stages.
- Victoria Bend Tow handling is erratic S/B and N/B at all stages.
- I found that all the bend weirs on the upper Miss. worked good for me.
- But at Victoria Bend, mile 594 LMR, someone goofed.
- Victoria has some bad boils and eddies in The Pocket that get real bad north and south bound at all stages.
- Victoria Bend weirs have made lower end swifter.
- The bendway weirs at Ft. Chartres create a difficult condition in low water. The water coming off the weirs is conflicting with the river flow. You have bendway weir water pushing on your starboard stern and river current pushing on your port head. At times the 2 forces easily over come the rudder power of the vessel and make controlling the tow difficult. Similar conditions exist at Victoria Bend LM 594.
- Victoria Bend S/B Aug of 1999 a very dangerous place; flanking all the current is running behind Blacks above and below the turn, it wants to quit flanking because there dead water in bend above coming in turn and it will try to top you around on bar. Its very difficulty to flank right now (9-7-99). N/B at Victoria on turn hard drift behind Blacks as tow goes over weirs in the bend. Very stressful with N/B heavy tow.
- Victoria created strong current to bar above weirs and current to shore under them but has been a definite improvement.

4 Post Construction Analysis

Pilot General Comments

In addition to the bend-specific comments, pilot general opinions concerning bendway weirs were received:

- I found that all the bend weirs on the upper Miss. Worked good for me.
- As with anything that effects current flow, weir projects consequentially
 affect navigation. Each weir field has characteristics that require
 "GETTING USED TO" after they are installed. Almost all of the
 projects have a tendency to "SET OUT" on the buoys when you are N/B.
- All-in all the weir projects are a vast improvement over the previous conditions. The only problem I see with the weirs is that in most locations the weir fields do not start far enough toward the upper part of the turn. This causes the middle and lower part of the turns to be about right, but the upper part is narrow and very swift above the weirs. If you have to flank one of them S/B the tow starts out flanking normal on the upper end then stops flanking when you get into the weir field. If you are moving down the river at current speed when this happens you are fixing to "BUTT THE BANK." About all you can do to avoid this is to slow down below current speed and "jerk" the head out of the bend a little to make it start flanking again.
- In all I'm very much in favor for weir dikes. They have done a great job.
- I'm not in favor of putting weir dikes at Bird Point Elevator. It's a bad idea.
- All in all I think the weir dikes have helped navigation a great deal.
- Where even the weir dikes are N/B there is a hard draft when you are coming up under them they will set you hard on the bar the slower moving the tow the harder it sets you.

Unconstructed Bendway Weir Systems

Two other bendway weir systems are currently being designed in the Lower Mississippi River. The White River weir system is currently being planned for construction near RM 599. For this system several alternative designs have been considered but final plans have not been formalized. The second proposed weir system in the Lower Mississippi has been planned in Walker Bend above the Highway 82 Bridge near RM 532 at Greenville, Mississippi. Final design for the latter weir system has not been completed.

Analysis of Reported Accidents

The U.S. Coast Guard Marine Casualty and Pollution Investigations Database for the calendar years 1993-1997 was searched for accidents reported at the bendway weir project sites on the Mississippi River. Accidents involving allisions, collisions, and groundings of vessels that occurred within one river mile upstream and downstream of each project were identified and analyzed. Accidents caused by other factors, e.g. equipment failure, etc., were not included in the analysis. The full accident database is shown in Appendix A. A summary of the accidents that occurred within the project sites during the five-year period and following the project construction completion date is presented in Table 3. Because of various project construction dates the values in Table 3 represent different sets of conditions for accidents in each bend; however, comparisons are instructive.

Greenfield, Eliza, Scudders, Picayune, St. Genevieve, and Ft Chartres have not had any recorded accidents since the projects were completed. Dogtooth, Cape Bend, Cape Rock, Red Rock, Mosenthein, and Victoria have all had more than one accident reported - most were groundings. Many involved only small tows (4 or fewer units, e.g. 3 barges and a towboat). Those accidents involving larger tows included:

- Victoria W.J. Barta 5 units
- Dogtooth M/V Harriet Ann 18 units
- Cape Bend M/V Arnold Sobel 5 units
- Cape Bend M/V Leslie B 6 units
- Red Rock M/B Transporter 9 units
- Kaskaskia Ray A Eckstein 23 units

The details of these accidents were not investigated in depth to determine specific cause or to what extent the presence of bendway weirs created critical conditions; however, these statistics do indicate that the weir projects did not eliminate accidents. Dogtooth Bend, Cape Bend, Cape Rock, Mosenthein, and Victoria all averaged at least one accident per year following weir construction.

Mosenthein was completed less than one year during the record but a relatively large number of accidents with small tows continued to occur in the area. Pilot comments collected during this study concerning the Mosenthein/Chain of Rocks vicinity were strong and negative.

Victoria Bend in the Lower Mississippi also had a relatively short history in the accident database after weir construction (about two years) but received significant negative pilot comments – often directed at both upbound and downbound transits. It had the second highest accident rate. However, the sizes of the tows involved in the reported accidents were relatively small (2, 4 and 5 units) compared to the predominant sizes of tows which operate on the Lower Mississippi (25, 30, 35, 42, up to 49 units).

Table 3. Sum	mary of	U.S. (Coast	Guar	d Acc	ident	Data	(1993	-1997))			
	Install.			Ac	cident	s (aft	er ins	tallati	on)		-	Num	ber of
Bend	Date	Grou	nding		ision		sion		tal	Tot	al/Yr		sels
		All	Post	All	Post	All	Post	All	Post	All	Post	All	Post
Greenfield	Oct-95	2				, ,		2		0.4		4	
Eliza	Dec-95												
Scudders	Dec-95	6				1		7		1.4		15	
Dogtooth	Dec-90	8	8			*******************************		8	8	1.6	1.6	34	34
Price's Landing	Nov-91	1	1			***************************************		1	1	0.2	0.2	2	2
Cape Bend	Mar-95	2	1	3	2			5	3	1.0	1.1	22	15
Cape Rock	Feb-92	5	5					5	5	1.0	1.0	10	10
Picayune	Feb-95	1						1		0.2		4	
Fountain Bluff	Jan-96	4	1			-		4	1	0.8	0.5	26	2
Red Rock	Jan-93	2	2	1	1			3	3	0.6	0.6	17	17
Kaskaskia	Mar-94	1				1	1	2	1	0.4	0.3	27	23
St. Genevieve	Sep-97			***************************************									
Ft. Chartres	Apr-94												
Carl Baer	Sep-96					1	1	1	1	0.2	0.8	2	2
Bellerive	Apr-96	1	1					1	1	0.2	0.6	1	1
Mosenthein	Apr-97	12	6			2	1	14	7	2.8	10.5	34	18
Victoria	95	6	4	1				7	4	1.4	2.0	22	15

While Dogtooth, Cape Bend and Cape Rock received some negative comments, the criticisms were relatively mild compared to others and did not indicate any serious problems. There were comments about a strong draft on the bar at Dogtooth and an eddy at the foot of Cape Rock, but these only came from one or two of the pilots. However, all of these bends had a relatively high number of recorded accidents involving large tows suggesting potential design problems.

Another observation from the analysis of the accident data was that there were no accidents reported near the bend at Ft. Chartres which received many negative comments from the pilots. There was special concern about northbound traffic and currents that made controlling the tows difficult. Apparently, these critical conditions have not resulted in accidents. Other bends that received negative pilot comments, especially for northbound tows and low water conditions, were

Greenfield, Eliza, and Scudders. As with Ft. Chartres, Greenfield and Scudders received some comments about difficult currents; however, Eliza received no pilot comments at all. Greenfield and Scudders had accidents prior to weir construction but none afterward. During the entire period of record no accidents were listed for Eliza bend.

Predominantly, conclusions concerning navigation difficulties drawn from the accident record paint a different picture than conclusions drawn from pilot comments received. It is probable that during numerous critical situations over the years (such as those mentioned in pilot comments) the "chain of events" that usually occurs in accidents did not fully develop and a reportable incident did not result. In such instances evidence of control problems would show up in negative comments but not in the accident database. The converse circumstance in which pilot comments were mild but the accident count was fairly high (Dogtooth, Cape Bend, Cape Rock) is more difficult to account for; however, it is highly unlikely that the pilots surveyed during the present study were the same ones involved in the reported accidents. Currently, a new reporting system is being initiated that will allow the anonymous reporting of incidents that might provide a better indication of navigation difficulties. The fact that several incidents are reported in the pilots' comments is an indication that the proposed system will be helpful in identifying channel reaches that should be considered for corrective action.

Summary of Survey Results

Each bendway weir project reach was unique and it is difficult to generalize the results of the characteristics. The radius of the bends involved ranged from 4,200 ft to 11,300 ft. The minimum width of the channel after construction ranged from 340 ft to 1,140 ft. The bend angle varied from 33 to 108 degrees. The degree of curvature ranged from 0.51 to 1.36 degrees per ft of arc.

In all of the Upper Mississippi River projects the design height of the weirs was set to -15 ft LWRP, while the only project in the Lower Mississippi River is set to -20 ft LWRP. The number of weirs in a project varied from 4 to 13. Many of the weir systems start deep into the bend relative to the upstream end. The length of the weirs varied from 296 to 1,420 ft with most being 400-700 ft long. The angle of the weirs to the curve tangent was normally between 50 to 75 degrees, ranging from a minimum of 42 to a maximum of 91 degrees. Generally the angles of the weirs were relatively uniform; however, in at least two cases there were unusual combinations of weir angles in the upper reaches of Ft. Chartres and Victoria bends. The minimum depth of water over the weirs ranged from 17.2 to 22.7 ft with the average being about 20 ft. The maximum water depth over the weirs was 66.3 ft. The maximum post-construction depth downstream of the weirs ranged from 16 ft to 85 ft while the nominal weir height post-construction ranged from 0 to 65.5 ft. Generally the weir fields tended to fill in behind the upstream weirs.

Post-construction current patterns were available only for Victoria Bend. These data showed an increase in current magnitude in the navigation channel, more uniformly distributed throughout the channel width. In direction, the currents tended to be more uniform along the length of the channel postconstruction. Because of this, the currents on the inside of the bend, i.e. along the point bar where the upbound tows tend to transit, are increased, sometimes significantly.

Navigation Changes due to Bendways

Based on the pilots' survey comments and rating sheets, some general trends can be observed in the changes that the weirs made to navigation conditions. Generally speaking, all pilots agreed that the weirs improved navigation conditions for downbound tows. Some comments, received in conversations with port captains, indicated that most projects cause some difficulties immediately after construction on the point bar because currents are increased due to the restricted channel area. The consensus in the towing industry is that for many of the bendway weir systems the channel continues to develop during the postconstruction period and navigation difficulties tend to lessen. The survey ratings indicated that most projects showed improvements in the navigation conditions for southbound tows except at Victoria and Cape Rock (under high flow) Bends. Red Rock was rated as having exceptional improvements in both north and southbound directions for both high and low flow conditions. Carl Baer was rated as having been improved in low flow conditions for both upbound and downbound traffic. Scudders was rated as having significant improvements for southbound transits under all flow conditions and Bellerive was rated as having significantly improved overall.

With few exceptions, all projects were indicated to have caused decreased tow speeds upbound over the weirs; due probably to increased current magnitude closer to the point bar where the northbound traffic transits. Greenfield was noted to have the largest decrease in speed, especially during low flows. The majority of pilots indicated erratic control due to turbulent flows for Dogtooth, Ft. Chartres, and Victoria Bends for medium and low flow conditions. More than half of those responding indicated that no erratic control problems occurred for northbound traffic.

Another indication of the improved navigation conditions for southbound traffic was the reduction in flanking required. In all cases and flow conditions, flanking use remained constant or decreased. This was particularly true for low flow conditions at Greenfield, Cape Rock, Fountain Bluff, Red Rock, and Ft. Chartres.

5 Test Plan Development

Considerations for Developing Test Plan

Only two bendway weir projects have received testing for navigation conditions using detailed current measurements and remote-controlled towboats. These are the approaches to the Greenville Bridge and the upstream approach to Montgomery Point Lock and Dam. Neither of these projects has been constructed yet and there is no prototype experience with these projects. However, in both model studies, unfavorable conditions were observed and corrected to some degree.

The initial designs for the Greenville Bridge bendway weir system were developed in a moveable bed model using 25-barge tows. In these design the model weirs were constructed to make the channel widen and push back the point bar from the outside of the bend. These designs were shown in the model to greatly improve the current patterns through the critical turn; however, because the last two weirs continued to be angled upstream and to direct the currents across the channel toward the left downstream bank, the currents tended to force downbound tows to the wrong side of the channel and increased the difficulty of the bridge approach. Changing the angles of these weirs to nearly 90 degrees to the flow corrected the problem. Upbound tows experienced stronger, more erratic currents, decreased tow speed and some control problems, especially when they transited near the end of the weirs on the inside of the bend. If the tows maneuvered so that they transited in the middle of the weirs, they experienced smoother flows and less erratic behavior of the head of the tow. However, the current continued to be stronger than before the weirs were introduced to the navigation channel.

The design tow for the Montgomery Point Lock and Dam project was a 6-barge tow. In the bend just upstream from the approach to the lock and dam, bendway weirs were introduced to improve navigation conditions through the bend and to assist in aligning for the lock and open-pass approach. During testing of the initial design, it was found that the spacing of the weirs was too wide and the tow length for an upbound tow would fit between weirs, i.e. the tow could be in a position where it was in the weir field but would not be over any individual weir. This caused the current pattern to be erratic and caused erratic behavior of upbound tows, creating control problems. This was serious enough that additional weirs were installed so that the tow would be over at least two weirs at all times.

This improved the navigation conditions greatly. In this project the depth of the channel was relatively shallow and the height of the weirs was not great.

Significant Factors for the Test Plan

The factors that must be considered for developing a bendway weir test plan that will provide guidance for design criteria include:

- 1. Bendway geometry
 - a. Radius of the turn,
 - b. Width of channel (at least the minimum width),
 - c. Angle of the bend
 - d. The shape of the channel cross-section, including the maximum depth of the channel bed.
- 2. Weir design factors
 - a. Weir crest elevation relative to the low flow conditions
 - b. Angle of the weir to the flow or tangent of the bend arc
 - c. Uniformity of the weir angles
 - d. Weir spacing
 - e. Starting point of the weir field relative to bend
 - f. Number of weirs.
- 3. Flow conditions
 - a. Varying the discharge
 - b. Varying the tail water
 - c. Varying slope of the water surface (however, the water surface slope will generally be determined by the roughness of the channel, including the weir field and will not be controllable to a large extent).
- 4. Traffic considerations.
 - a. Tow size (length and width),
 - b. Tow travel direction,
 - c. Position of the tow while transiting the weir field, and
 - d. Whether two-way traffic must be maintained or if the design can allow one-way traffic.

A range of tow sizes in the same channel geometry and weir field layout must be tested as there is some evidence from the accident data and previous model tests that small tows may have more difficulty in a given weir field than larger, more typical design tows.

There are other factors that probably should be considered but, due to limitations in the research project resources, cannot be included. In the development of design criteria for bends, it was found that the distance between bends, i.e. the length of the crossing, influenced the channel width requirements. In one case, Cape Rock, two bends were designed as one bendway weir project and the angles of the weirs developed as if there was only one bend when in fact there were two bends with a very short crossing between them. The other factor found in the projects that have been built that is unusual involves a channel split that occurs in the bend. Mosenthein represents this condition where the Chain of Rocks Canal exits on the outside of the bend and the flow continues in the main part of the channel where the bendway weirs are located. Since this is special project consideration and should probably not be considered in developing general design criteria, this factor will not be considered in development of a test plan.

Testing Environment, Scale, and Time of Operations

The research program for developing the navigation design guidance for bendway weir projects has been established and initiated. There are three years to perform the test program and \$575,000 available for measurements, analysis, and reporting. A test flume has been dedicated to this testing which has dimensions 200ft x 75ft x 2ft with reversible flow up to 20 cubic feet per second (cfs). The test channels will be constructed in packed sand with generic weirs, probably made of tin or aluminum for easy installation and removal. Generally, major changes in channel geometry will require several weeks and will cost approximately \$20,000 to execute. Major changes will involve significant movement of sand and will occur when channel widths and radii are changed. Changes in degree of the bend will also require significant construction efforts but may not require the same level of effort that changing the radii and width will require as only a portion of the channel must be modified and the sand will basically be moved from one side of the channel to the other. It is estimated that a change in degree of bend could cost \$10,000.

Minor changes will be required to change the weir field layout. This will primarily be accomplished by inserting pre-constructed weir plates at particular angles. Time and cost can be reduced by starting the tests with wide weir spacing in the downstream end of the bend. The weirs can then be added to the upper portion of the bend to determine the impact of extending the weirs upstream into the bend approach channel. As a next step, weirs can be inserted between the widely spaced weirs to determine the impact of weir spacing. After a series of tests for a specific bend geometry and weir angle design, the weirs can be pulled out and reset for different angles with a repeat of the pattern for installing the weirs. At some point, a mixture of weir angles should be tested. It is estimated that it should only take a day or two to make these types of adjustments in the weir fields being tested. These operations will probably require approximately \$15,000 per change in weir angles.

Once a channel geometry and weir field is established in the model, various tow sizes, directions of travel and track paths can be tested for different flows and water depths over the weirs. These transits and the resulting current patterns will be recorded using the overhead video tracking system. Estimating approximately 5 runs/hr, a complete set of measurements for one weir angle will require approximately 5 weeks and \$11,000.

Based on this analysis of resources and the effort required to perform the necessary model tests and the analysis of the existing bends described above, it was determined that only a limited test program can be undertaken; that is, the large number of factors that need to systematically tested and the resulting combinations of test sets will require more time and funds than are available. Therefore, it is recommended that a limited set of conditions be tested and that the tests focus on determining which factors are most significant in determining safe navigation conditions as early in the testing program as possible. In order to accomplish this, the test program must focus on only a few channel geometries and do as much as possible in varying the layout of the weir fields and tow sizes and transit paths. The tests should focus primarily on upbound transits and a range of tow sizes, including relatively small tows.

It is proposed for the first and second year of the research work \$36,000 and \$46,000, respectively, be set aside for project management and analysis of the results, and approximately \$93,000 be set aside during the final year for management, analysis and reporting. The remainder of the yearly funds will be \$164,000, \$154,000 and \$82,000, respectively, to pay for the proposed model testing program. The proposed testing program will be limited to eight sets of conditions for bend geometry consisting of combinations of two bend radii (4000 ft, 8000 ft), two channel widths (500 ft, 900 ft), and three degrees of bend (110 deg, 75 deg, 60 deg). For each of the eight geometric test conditions, the proposed test program will consist of combinations of three weir angles (45 deg, 60 deg, 75 deg), two flow conditions, three track paths and 3 tow sizes (4, 15, 30) transiting upstream and downstream with either 5, 10 or 20 weirs placed in the bend. The three track paths will be along the outside and inside of the weir system and through the middle. Downbound runs will follow a track path on the outside of the bend only. The 75-deg bend angle will be tested in the 4000-ft radius bend to give some additional information concerning the impact of the degree-of-bend.

		TABI	LE 4 – Model	Testing	Progr	am Cost		
				Estimate	d Cost			
			Mode	el Costs			Management	Annual
Year	R/W/Deg	Construct	Modify Weirs	Testing	Total	Cumulative	& Analysis	Budget
1	4000/500/110	20	15	11	46	46		
1	4000/500/75	10	15	11	36	82		
1	4000/500/60	10	15	11	36	118		
1	8000/500/110	20	15	11	46	164	36	200
2	8000/500/60	10	15	11	36	200		
2	4000/900/110	20	15	11	46	246		
2	4000/900/75	10	15	11	36	282		
2	4000/900/60	10	15	11	36	318	46	200
3	8000/900/110	20	15	11	46	364		
3	8000/900/60	10	15	11	36	400	93	175

The proposed test channel width of 900 ft is intended to represent a typical bend in a large river system such as the Lower Mississippi. The 500-ft channel width is intended to represent a bend in a relatively smaller river such as the Middle Mississippi or possibly another waterway such as the Red River for which bendway weir systems may be proposed and built in the future. Because of the different focus of these channel width the proposed high and low flow rates to be tested will be different. For the 900-ft channel the test flow rates proposed are based on the January 1995 through December 1998 discharge record from the recording gauge at Arkansas City, Arkansas. The proposed flow rates for this case are based on the cumulative discharge distribution where the 10th percentile (low flow) was 288,000 cfs and the 90th percentile (high flow) was 1,050,000 cfs. For the 500-ft channel the test flow rates proposed are based on the January 1990 through September 1998 discharge record from Thebes, Illinois. The proposed rates for this case were also based on the cumulative discharge distribution with the 10th percentile discharge of 125,000 cfs (low flow) and the 90th percentile of 492,000 cfs (high flow).

Proposed Physical Model Test Plan

The recommended test plan for the first year is as follows:

- 1. Construct a 500-ft wide channel with a bend of 4000 ft and a deflection angle of 110 degrees. (20K)
 - 1.1. Place 5 weirs equally spaced in the downstream half of the bend angled with the upstream direction at 45 degrees. (5K)
 - 1.1.1.Conduct 5 runs for each set of conditions made up of combinations of three tow sizes, two flows, two directions and three track paths.

 The downbound tests will be limited to a track path along the

outside of the bend. (total 120 runs at 5 runs/hr at \$50/hr for technician -1.2K)

- 1.2. Add 5 more weirs equally spaced filling out the upstream half of the bend.
 - 1.2.1. Repeat 1.1.1 (1.2K)
- 1.3. Place additional weirs midway between in-place weirs. Place an additional weir at downstream end to total 20.
 - 1.3.1.Repeat 1.1.1 (1.2K)
- 1.4. Repeat 1.1 through 1.3 with weirs angled at 60 degrees. (8.6K)
- 1.5. Repeat 1.1 through 1.3 with weirs angled at 75 degrees. (8.6K)
- 2. Modify model to change the bend deflection angle to 75 degrees (10K)
 - 2.1. Repeat 1.1 through 1.5 (25.8K)
- 3. Modify model to change bend deflection angle to 60 degrees (10K)
 - 3.1. Repeat 1.1 through 1.5 (25.8K)
- 4. Construct a 500-ft wide channel with a bend of 8000 ft and a deflection angle of 110 degrees (20K)
 - 4.1. Repeat 1.1 through 1.5 (25.8K)

The recommended test plan continuation for the second year is as follows:

- 1. Modify model to change the bend deflection angle to 60 degrees (10K)
 - 1.1. Repeat 1.1 through 1.5 from first year plan (25.8K)
- 2. Construct a 900-ft channel with a bend radius of 4000 ft and a bend deflection angle of 110 degrees. (20K)
 - 2.1. Repeat 1.1 through 1.5 from first year plan (25.8K)
- 3. Modify model to change bend deflection angle to 75 degrees (10K)
 - 3.1. Repeat 1.1 through 1.5 from first year plan (25.8K)
- 4. Modify model to change bend deflection angle to 60 degrees (10K)
 - 4.1. Repeat 1.1 through 1.5 from first year plan (25.8K)

The recommended test plan continuation for the third year is as follows:

- 1. Construct a 900-ft channel with a bend radius of 8000 ft and a bend deflection angle of 110 degrees (20K)
 - 1.1. Repeat 1.1 through 1.5 from first year plan (25.8K)
- 2. Modify model to change bend deflection angle to 60 degrees (10K)
 - 2.1. Repeat 1.1 through 1.5 from first year plan (25.8K)

Appendix A U.S. Coast Guard Casualty Data (1993 – 1997)

Bendway Weirs	Case	Dete	Time	Description	Waterway	9100	Incident Tyne	Damane Ves	1	Versel Name	Rneed	Demand
	MC93010781	16-Jun-93	-	EAL BREAKAWAY/GROUNDING	I OMER MISSISSIPPI RIVER	4=	CROHINDING	15	+=	MM-72	8	STAPROAF
	MC83010781	16-Jun-93		2145 GENE NEAL, BREAKAWAY/GROUNDING	LOWER MISSISSIPPI RIVER		GROUNDING	\$8,000.00	3	100 MIM-70	•	STARBOARD QUARTER
	MC95014718	14-Sep-95	_	VET	LOWER MISSISSIPPI RIVER	584 G	GROUNDING	\$0.00	8	RW 251		PORT BOW
	MC84005736	21-Mar-94	2245 MW SUS	2245 MAY BUSAN K & MAY MR. TOM			COLLISION	\$33,900.00	Ē	TC 120		PORT BOW
	MC94005736	21-Mar-94	2245 MW SUS,	2245 M/V SUSAN K & M/V MR. TOM			COLLISION	\$33,900.00	<u>ಹ</u>	BUNGE 117		STARBOARD QUARTER
	MC84005/36	ZI-Mar-DE	2245 MW SUS	2245 M/V SUSAN K & MV MR. TOM	LOWER MISSISSIPPI RIVER			\$33,900.00	<u></u>	BUNGE 871B		STARBOARD QUARTER
	MC96002790	18 Feb. Of		AARON G COLLISION	LOWER MISSISSIPPI KIVER	9 6	GROUNDING	not noted 2	¥ ā	JO ANNE STEGBALLER		PORT BOW
	MC93020529	10-Nov-93	_	830 MV ANDREW CARGILL MACMILLAN			c	\$50.000.00		KU 268		BOST BOW
	MC93020529	10-Nov-93	830 MV AND	830 MAY ANDREW CARGILL MACMILLAN	_		GROUNDING	_		XI. 297		PORT BOW
	MC93020529	10-Nov-93	830 M/V ANDF	MAY ANDREW CARGILL MACMILLAN			GROUNDING	\$50,000,00	<u> </u>	XL 152		PORT BOW
	MC93020529	10-Nov-93	830 M/V ANDF	M/V ANDREW CARGELE MACMILLAN	RIVER	-	GROUNDING	\$50,000.00	₹	ANDREW CARGILL MACMILLAN		STARBOARD QUARTER
	MC95003324	23-Feb-95	2342 MAY ROBE	M/V ROBERT N. STOUT			EQUIP FAIL	\$20,000.00	3	MF 91		NOT NOTED
Victoria	MC97014605	2-Oct-97	150 M/V OLINDA- C	DA-C		_	GROUNDING	\$8,500.00	8	DC 374		STARBOARD BOW
Victoria	MC95004074	10-Mar-95	330 MAY RANG	330 M/V RANDY ECKSTEIN		<u>3</u>	GROUNDING	\$1,500.00	¥	AGS 703		NOT NOTED
Victoria	MC95004074	10-Mar-95	330 MV RANC	M/V RANDY ECKSTEIN	_	_	GROUNDING	\$1,500.00	ž	NOMA 249		NOT NOTED
Victoria	MC95014238	6-Sep-95	545 W.J. BART	W.J. BARTA, GROUNDING	_	_	GROUNDING	\$9,045.00	<u> </u>	VL 7601 ·	n	PORTBOW
Victoria	MC95014236	6-Sep-95	545 W.J. BAR	W.J. BARTA, GROUNDING	RIVER	-	GROUNDING	\$9,045.00	<u>8</u>	ACBL 3051	6	PORT QUARTER
Victoria	MC95014238	6-Sep-85	545 W.J. BAR	545 W.J. BARTA, GROUNDING			GROUNDING	\$9,045.00	<u> </u>	W.X 7350	6	STARBOARD QUARTER
VICTORIA	MC85014238	Carden o	SAS W.J. BAR	TA, GROUNDING			GROUNDING	\$9,045,00	<u> </u>	Gii 108	m	STARBOARD QUARTER
Victoria	MC83010400	CR-100-01	SOU MAY DOWN RUSHING	NA NOSHING			GROUNDING	\$35,000.00	<u> </u>	CH 83/8		NOT WOTED
Virtoria	MC03002445	20 40 3	1846 BILL AND	1945 DILL ANDREWS COLLIDED WITH	_	_	COLLISION	222,000.00	3 8	SC 345 S		PORT MIDSHIP HALF LENGTH
Victoria	MC33002443	2 1 2 2	1954 DILL AND	AINEY JONES COCIDED WITH	LOWER MISSISSIPPI KIVER		COLLISION	\$22,000,00	3 2	CBA 223		STARBOARD BOW
Victoria	MCQ4025931	10 Nov. Oc		TOH DAY	-	2 4	GROUNDING	320,214.00 2	<u> </u>	FV 3877		PORT BOW
	MC97013587	21-5-0-97		MV NERBASKA CITY			GROUNDING	0000	t 8	Ert seis		STABBOARD BOS
	MC98009621	7-Jun-96	1630 S/R KENTUCKY	TUCKY	RIVER	_		not noted	5 8	SAR BARCE NO 204		NOT NOTED
	MC96009621	7-Jun-98		TUCKY				not noted	3 0	S R RABGE NO ANI		NOT NOTED
	MC96009621	7-Jun-96		TUCKY				not noted	0	S R BARGE NO. 411		NOT NOTED
	MC96001747	2-Feb-96	1030 MV J S M	MV J S MCDERMOTT	LOWER MISSISSIPPI RIVER			\$500.00	-3	73043		STARBOARD BOW
	MC95015208	24-Sep-95	850 M/V STON	M/V STONE POWER		_		not noted 3	S 28	62		NOT NOTED
	MC95015208	24-Sep-95		M/V STONE POWER		-		not noted 3	S-25	25		NOT NOTED
	MC33020131	CR-NON-N	2155 JOSEPH N	JOSEPH MERKICA JONES, AGROUND		-	GROUNDING	20.00	¥ .	AGS 627B		STARBOARD BOW
	MC03020151	A Most 63		JOSEPH MERNICK JONES, ACROUND	LOWER MISSISSIPPI KIVER		GROUNDING	00.00	2 6	(35 5396		STARBOARD BOW
	MC93020151	4-Nov-93		JOSEPH MERRICK JONES AGROUND	-	5 6	GROUNDING	00.00	2 5	AGS 638B		STARBOARD BOW
	MC92007014	21.Anr.03	950 CGBAWATI	CORMATEREONT #5 # 46 E1 CETS		-		MOT MOTED	3 8	CCB 466		STANBOARD BOW
	MC94003309	16-Feb-94	2155 MV BOB S	MAY BOB STITH 0 UMR	UPPER MISSISSIPPI RIVER			4 INDICATE	3 3	CGB 100	-	STABBOARD BOW
	MC94003309	16-Feb-94	2155 M/V BOB		UPPER MISSISSIPPI RIVER	0	COLLISION	\$8,300.00	¥ C	ACRI 1267		PORT BOW
	MC96013331	28-Aug-96	5 MV JO AN	UER 1.3, UMR	UPPER MISSISSIPPI RIVER	- Y	ALLISION	\$750.00	Z	N.M.S. NO. 2507		PORT QUARTER
	MC96010039	3-Ju-96	2140 MV TWYLA A. 01.3 UMR		UPPER MISSISSIPPI RIVER	₹	NOTE	\$175,000.00	1.2	2118		STARBOARD QUARTER
	MC98010039	3~101-96	2140 MV TWYL		UPPER MISSISSIPPI RIVER	₹	ALLISION	\$175,000.00	3	331		STARBOARD QUARTER
	MC95005697	7-Apr-95	330 MV GLOR		UPPER MISSISSIPPI RIVER	₹:	ALLISION	\$156,000.00	8	BUNGE 344	10	PORTBOW
	MCS2002637	CB-104-1	330 MAY GLOK	MAY GLORIA G. 001 UMR	UPPER MISSISSIPPI RIVER	₹ :	MISION	\$156,000.00	Ş	AGS 951	5	STARBOARD BOW
	MCB3006463	14.Anr.93	2210 All - MAY 8	BD	UPPER MISSISSIPPI KIVER	₹ ₹	ALLISION	\$50,000,000 \$30,000,000	M128	M128	•	PORT MIOSHIP HALF LENGTH
	MC93006463	14-Apr-83	2210 ALL: M/V J	· ·	UPPER MISSISSIPPI RIVER		N I ISION	\$30,000,000	2 6	RB7 &	o «	DODE BOW
	MC93008737	14-May-93	1100 MAY CITY	3 UM	UPPER MISSISSIPPI RIVER	· -	ALLISION	\$40,000.00	8	CBL 306	•	STARBOARD QUARTER
	MC93008737	14-May-93	1100 MV CITY C	HUNTINGTON 01.3 UM	UPPER MISSISSIPPI RIVER	7	ALLISION	\$40,000.00	క	OR 3629		STARBOARD QUARTER
	MC93012770	52EF83	315 M/V STEVE T	1	UPPER MISSISSIPPI RIVER	₹		\$86,000.00	8	PV3859		PORT MIDSHIP HALF LENGTH
	MC93016031	2000	2350 MAY ALOIS LUHR	TELL AND LINED	UPPER MISSISSIPPI RIVER	₹ :		NOT NOTED 2	-	1-1021	၈	STARBOARD MIDSHIP HALF LENGTH
	MC93018484	70-1-93	2030 MAY RAND	< 0	INDEED MISSISSIPPLINING	₹ 3	ALLISION	2345,150.00	- 2	1-/831		PORT GOARTER
	MC93018484	7-Oct-93	2030 MV RAND	<u></u>	UPPER MISSISSIPPI RIVER		ALLISION	X345 150.00	3 2	BUNGE 713		PORT CHARTER
	MC93017019	19-Sep-93	1835 CRIMSON		UPPER MISSISSIPPI RIVER	2	ALLISION	\$65,500,000 2	<u> </u>	XL 144		STARBOARD BOW
	MC93009608	27-May-93	2345 GRD: MV		UPPER MISSISSIPPI RIVER	2	GROUNDING	\$24,020.00	8	DANIEL WEBSTER		STARBOARD QUARTER
	MC93009608	27 May 93	2345 GRD: MV		UPPER MISSISSIPPI RIVER	2	GROUNDING	\$24,020.00	20	DM 2575		PORT QUARTER
	MCBSGGGGG	27 May-83	2345 GRU: MAY	2345 GRU: MV DANIEL WEBSTER 2.4 UM	UPPER MISSISSIPPI RIVER	5 6	GROUNDING	\$24,020.00	S	SER 162 B		PORTBOW
	A STREET, ST.											

Weirs	Case	Date		SOND CONTRACTOR	A A A A A A A A A A A A A A A A A A A	- Automated		A CONTRACTOR	-		TODA'S	CONTROL OF STREET
	MC95013449	<u> </u>	1900 M/V B	1900 M/V BOB STITH 03 UMR	UPPER MISSISSIPPI RIVER	3	GROUNDING	\$750,00 2	A AC	ACBL 2889		PORT MID:
Greenfield	MC93002595		2240 GRD:	2240 GRD: MIV RITA BARTA MI. 3.0 UM	UPPER MISSISSIPPI RIVER	e .	GROUNDING	\$0.00	30	SCNO 8013	6	PORT QUARTER
	MC95010641	4-101-95	1900 MIN	1900 MAY LARRY Y. STRAIN 5 UMR	UPPER MISSISSIPPI RIVER	· .	EQUIP FAIL	\$12,000.00	8	SCNO 8012	~	STARBOARD BOW
	MCSSG LOSS		FROO MAY C	SOU INTO CARRET 1. STRAIN SOURCE	UPPER MISSISSIPPI KIVER	n +	EGUIP PAIL	\$12,000,00	= 6	I BL 4005	N 1	STARBOARD BOW
	MC86013993	11-Sep-96	530 MV C	530 MV CONNELL SMITH 74 UMR	LIPPER MISSISSIPPI RIVER		FOLIP FAIL	not noted 2	3 5	MIC 103B		CONTINUES DATE ENGIN
	MC93020542	10-Nov-83	1120 M/V S	1120 M/V SHEILA JOHNSON 12.5 UMR	UPPER MISSISSIPPI RIVER	. 2	GROUNDING	\$0.00	0	DC-370	- 40	STARROARD ROW
	MC93009605	27-May-93	1700 COL: 1	1700 COL: MV JEFFBOAT/HUFFMAN 13.8	UPPER MISSISSIPPI RIVER		COLLISION	\$41,000.00	AC	ACBL 312X		PORT QUARTER
-	MC93009605	27-May-93	1700 COL: 1	1700 COL: M/V JEFFBOAT/HUFFMAN 13.8	UPPER MISSISSIPPI RIVER		COLLISION	\$41,000.00	H	H 121 B		PORT QUARTER
	MC93008605	27-May-93	1700 COL: 1	1700 COL: M/V JEFFBOAT/HUFFMAN 13.8	UPPER MISSISSIPPI RIVER		COLLISION	\$41,000.00	8	CGB 341		PORT BOW
Scudders	MC95001710	30-Jan-95	1750 M/V G	1750 M/V GLORIA G. 16 UMR	UPPER MISSISSIPPI RIVER	*****	GROUNDING	\$6,500.00	N N	AGS 528		PORT BOW
	MC94025510	14-Dec-94	H VWI CLS	615 MAY KANDY ECKSTEIN 16 UMR	UPPER MISSISSIPPI RIVER	Distance of the Control	GROUNDING	\$5,000.00	<u>8</u>	CC8312	9	PORT BOW
	MCS4025109	_	J A/WIGEL	TASIMIV CONTI SUSANTE UMR	OPPEK MISSISSIPPI KIVEK		CHOUNDING	\$12,000.00	<u>8</u>	CCT 77	2	STARBOARD BOW
Scudders	MCSSCOORT		1240 MIV V	TANGIMA W.I. I COLIANI 16 UMK	UPPER MISSISSIPPI KIVER		GROUNDING	\$6.400.00	¥ :	ACBL 307X	2	PORT BOW
	MC93001018		SOO GRD:	TUG-TOW 16.6 UMR	UPPER MISSISSIPPI RIVER	-	GROUNDING	\$200.00	5	CBX 36	_	PORT BOW
	MCSSUZUGOS	PR-NON-5	TISU UMK	TISULUME 16.6 MIV MILLAND STAK	OFFER MISSISSIPPI KIVER	9 !	GROUNDING	NOT NOTED 2	5	ORG 2559		PORT BOW
Schange	MCS3001280	CB-1180	A AMIN COC	AND THE PARTY OF T	Urren Mississifri River	- :	ACLISION OF	24,000:00	3 1	CGB 123		TOX COAX EX
	MCS/CICAROS	44 March	SEE MAN	CANADA SOLO SE LA COMPANIA DE LA COMPANIA DEL COMPANIA DE LA COMPANIA DEL COMPANIA DE LA COMPANI	UPPER MISSISSIPPI KIVER	> 9	COOL PAIL	9250.00	ž (KOBERI N. SICOI	,	POKI GOAKIEK
-	MCG5014884	A Sen OF	ASO MAY S		LIDDED MACCINEDID DIVED		SHIGHTONS	92,000.00	200	17.17.1	•	POKI BOW
	MC95014114	28. A.m.98	215 MAY C		LIDDED LINGSFEIDER DIVED	2 4	GROUNDING	TOT HORAL	2	MDC 414	0	SIARBOARD BOW
	MCGSO14114	28.A.IO.95	255 MAY C.	24% MAY CONT! SESAN 20 INCO	I IDDEED MISSISSIDE DIVED		Chicking	6600.00	2 2	200		MOS HOOS
	14C0300000E		2346 COL	MANAGEMENT AND THE STATE OF THE	LIDDED AMOCIOCIDI DIVED		SALONOONS SALONOONS	9300.00	2 6	MA 420		PURI BOW
	MCGGCGGGG		2346	AAAA AAAA SABII I AAACHI CI OO I IAAB	CTTCA MISSISSIPPLIATED		NO FEEDON	942,300.00 943,500.00	0 0	0ER 234		STARBOARD BOW
	MCSCOROES		2946 COL:	2042 COL: MIV MACMILLANDIE & UMA	LIDOGO PROCISOIDES DECE	5 7	COLLISION	\$42,500.00 642,500.00	2	BUNGE 492		STARBOARD QUARTER
Dogwooth	ALCORO17889		2246 8407 E	ADDIET ANN 22 CHAD	STATE MISSISSIPPINGE	- 5	COLLISION	944,500,00	5 6	DM 2807		SIARBOARD GUARIER
	MC30017000		TANK STORY	ASSESSMENT AND SECURITY AND SEC	UPPER MISSISSIPPI RIVER		SHOUNDING	\$148,500.00	5	PML 713		STARBOARD QUARTER
noolbon	MC80017866	04-NON-07	ASTO MAY F		UPPER MISSISSIPPI RIVER	3 8	GROUNDING			KW 8368		STARBOARD QUARTER
	MC08017888	Se Monday	2346 840/11		UDDED HEROEGOSTITI NIVER	-	SACONDING	4140,000,00	2 2	KWY DOOM		SIARBOARD GUARIER
	MC30017000		2345 MAY F	2315 MAY TANKEL ANN 22 UMR	CHIER MISSISSIPPI KIVER	-	GROUNDING			KW 123		STARBOARD QUARTER
	MC20017000		SOUTH BANKE		בשיים וביים מיים מיים מיים מיים מיים מיים מיים		SKOUNDING		2	KW 243		SIARBOARD GOARIER
	MCSGG17668	28-Nov-98	2315 MAY H		LIDGED MISSISSIPPLIATION	-	GROUNDING	\$146,500.00	0 0	KW 607		STARBOARD GUARTER
	MC98017888		SAIS MAN		LIBORED MISCISSIDE DAVED		SHOW I COS	6140,000,00	0 0	TAY OLLE		STANDOARD LOANIER
	MC96017688		2315 MV H	2315 MA/ HARBIET ANN 221 MD	Libber Mississippi pa/ee		SHICKLOSS	#146,000,00 #446 E00 OG	0 0	MBL 419		STANDONNO CONTRA
	MC96017668		2315 MV H		II IPPER MISSISSIDIO RIVER		SHOWLORD	6148 FDD 00		MBI 408		CHACAGO COACAGO
	MC98017868	28-Nov-96	2315 MV H	2315 M/V HARRIET ANN 221 MR	I IPPER MISSISSIDE BIVER		GROUNDING	6148 500 DD	0 0	MEDL 400		STANDOAND CONTINUES
	MC96017668		2315 M/V H		LIPPER MISSISSIPPI RIVER		GROUNDING	\$148 500 00 15	3	0 0		STABBOARD OLDER
	MC96017668		2315 MV H	2315 MV HARRIET ANN 22 UMR	LIPPER MISSISSIPPI RIVER		GROUNDING	\$148 500 00	4 A	ABC 349		SOUTH TO SOUTH THE SOUTH T
	MC98017668		2315 M/V H		UPPER MISSISSIPPI RIVER		GROUNDING	\$148 500 00		MEDE SECTOR		POPT OI METER
	MC96017668		2315 MV H.	2315 M/V HARRIET ANN 22 UMR	UPPER MISSISSIPPI RIVER		GROUNDING	\$148 500 00	8	RWASOB		STARROADD GUARTER
	MC95001951		1100 MV L	\$	UPPER MISSISSIPPI RIVER		GROUNDING	\$1,200.00	5	Ut 81728	٠	HEADY BURSHING HALF I FINAL
	MC95006055	9-Apr-95	1930 MV R	1930 MAY RANDY ECKSTEIN 22.8. UMR	HAPPER MISSISSIPPI RIVER		GROUNDING	\$1 000 000 3	IN A	NG ADEA	4	STADBOAD BOW
	MC94011157	3-Jun-84	1300 M/V H	1300 M/V HENRY B. 23 UMR	HIPPER MISSISSIPPI RIVER		GROUNDING	\$8 570.00	ā	2000	-	STANDON CONCENTRATION OF THE PROPERTY OF THE P
	MC94019440	11-Sep-94	515 MV R	515 MV RAY A FCKSTFIN 23 IMP	HODER MISSISSIDE BIVED	******	ONION TODO	60.00	200	20.303	- •	SOUTH BOTH
	MC93020783	15.Nov.93	23 VIN OCEC	2320 AM COSEDH MEDDICK LONES	HIDDED MISSISSIDE DIVED	*****	SPICINI MONE	ALOT MOTED	000	3 202E	, -	MOG FEOG
	MC93009367	28.May.93	1820 MV H	1800 MAN HERMAN POTT	HOOGO MISSISSIDE DEVED	-	EOI IID EAN	CO COO CO	2 9	TOP TOP	- ‹	TOOL BOW
	MC97011949	23-ltd-97	1540 MV R	1540 MV RILL FLIMER 24 IMPR	II DOCK MISSISSIDDI BIVED		SECH LOSS	640,000,00	1 4	261 254	4	STADBOARD BOW
	MC95017398		1330 MAY D	DICK HARRISON OA 1840	HODED MICCICCIDA DAVED	******	CHICINICAL	67 EGG OO		14 DOC 1 210		STANDED CONTRACTOR
	MC95017398		1330 MV D	1330 MAY DICK HABBISON 24 1940	HIDDED MISSISSIDE ON CO.	1 8	GNOONDING CONTINUED	67 500.00	2 4	NGE 1410		STARBOARD BOW
	MC95017308		1330 MAY	1320 MAY DICK HADDISON OF 1840	HOOFE ANGEREDING BAVER	-	SALCINICIAN OCCU	97,000,00	ζ.	ABS 1402		SIARBOARD BOW
	MC08017020	P. Der 96	1238 MAY K	1000 MAY KAY A FORSTEIN MEDICAL MAD	LIDDED MISSISSIFFI NIVER	-	GROUNDING	97,000.00	3 6	UE 6623	•	STARBOARD MIDSHIP MALF LENGTH
	MCCCCCC CEC	74. len 04	114011111	1440 1810 28 7 MA/ CI AVA IL DI ACKE	INDUCTO MICOROGICA CONTROL	******	SALCINIONS SALCINIONS	00.00	9	200	0	SI ARBOARD BOW
	MC24001400	24 111 04	NAME OF THE PERSON OF THE PERS	THOUGHT AND THOUGHT OF THE PARTY	UPPER MISSISSIPPI KIVER		SHOUNDING	00.00	¥ :	ACHL 2821		STARBOARD MIDSHIP HALF LENGTH
	MC34001460	24 100 04	1440	1440 THE SET WAY FLOT DESCRIP	UTTER MISSISSIPPI RIVER		GROUNDING	90.00		ML /13 B		STARBOARD MIDSHIP HALF LENGTH
	12C04001400	24 21 24	4440 UMP	1440 CMC ASS. MAY FLOTE TO BLASKE	UPPER MISSISSIPPI RIVER	9 8	GROUNDING	00.00	<u>ر ب</u>	ACBL 4121		STARBOARD MIDSHIP HALF LENGTH
	MCORPORTAGO MCORPORTAGO	45 lon de	AND OFF	ASSESSMENT AND THOSE SAME	OFFER MISSISSIPPI KIVER		GROUNDING	90.00	¥ :	-51_2642		STARBOARD MIDSHIP HALF LENGTH
	MCSOCHONO MCSOCHONO	13.28H-83	430 MIV L	ASSESSION SCHOOL STATES OF COMPANY OF STATES OF COMPANY OF STATES OF COMPANY OF STATES	OFFER MISSISSIPPI KIVER	_	GROUNDING	\$0.00	2	MV LAINEY JONES		PORT QUARTER
	MCSCCOAGAC	CR-URIT-CI	A SOUTH A	SOLMY LAINET SONES ST CHAR	UPPER MISSISSIPPI KIVER		GROUNDING	20.00	11	E1 453		PORT QUARTER
	MC94023300	11-NOV-84	SOUND	SOUNT SETTEMENT OF THE	LOCATE MISSISSIPPI KIVEK	3 8	BREAKAWAY	4,600.00	× .	ACBL 2850		STARBOARD QUARTER
	MC97015552	21-Orf-97	300 M/V A	SOUMY ABNOLD SOBEL 37 BMP	LIDDED MISSISSIPPI NIVER		DREALANAWAT	94,000.0U	2 -	ACBL 31/6		POKI DUAKIEK
	MACGROCEROE	20 20 20			ATAIN LEGISTICS COLORS		りとうとうとう	20000000	2	200		から かんり ひこうかん にん
			7	A LANGE STREET & A STREET	THE RESIDENCE OF THE PARTY OF T	90	AN I IOIOAR	000000000000000000000000000000000000000			•	

MC9002868 MC96013890 MC96013890 MC96014845 MC96014845 MC9601859	888 28-Feb-97 888 889 12-Sep-98 889 12-Sep-98 889 12-Sep-98 884 12-Sep-98 889 12-Sep-98 88-Feb-98 889 889 889 889 889 889 889 889 889	1040 MAY NORA PICKETT 41 UMR 12150 MAY COOPERATIVE SPIRIT 41 12150 MAY COOPERATIVE SPIRIT 41 12150 MAY COOPERATIVE SPIRIT 41 13151 MAY ELIZABETH ANN 41 UMR 13150 MAY DE LASALLE 41 UMR 13150 MAY DE LASALLE 41 UMR 13150 MAY DE LASALLE 41 UMR 13150 MAY GENE NEAL 42 UMR 1315 MAY GENE NEAL 42 UMR 1316 MAY GENE NEAL 42 UMR 1316 MAY GENE NEAL 42 UMR 1317 MAY GENE NEAL 42 UMR 1318 MAY GENE NEAL 42 UMR	UPPER MISSISSIPPI RIVER UPPER MISSISSIPPI RIV	GROUNDING GROUND	\$2,000,000 2 \$0.000 3 \$0.000 3 \$0.000 3 \$0.000 3 \$0.000 2 \$0.000 3 \$0.000 1	STCO 226 COASTAL 2003-L ART 2458 ART 445 RCC 100		PORT MIDSHIP HALF LENGTH STARBOARD BOW FORT QUARTER PORT BUARTER PORT BOW
MC9900 MC9901 MC9901 MC9901 MC9900 MC900 M		1150 MAY ORDAR FIGNETT 41 UMR 1150 MAY COOPERATIVE SPIRIT 41 1150 MAY CLOOPERATIVE SPIRIT 41 1150 MAY DE LASALLE 41 UMR 11500 MAY DE LASALLE 41 UMR 1150 MAY GENE NEAL 42 UMR		GROUNDING GROUNDING	\$0.00 \$0.00 \$0.00 \$0.00 \$0.00 \$0.00 \$0.00 \$0.00	COASTAL 2003-L ART 2458 ART 445 RCC 100	•	STARBOARD BOW PORT QUARTER PORT QUARTER PORT BOW
MC9803M MC980M MC9803M MC980M MC980M MC980M MC980M MC980M MC980M MC990M MC990M		2120 MV COOPERATIVE SPIRIT 41 1945 MV ELUZABETH ANN 41 UMR 1355 MV BETUZABETH ANN 41 UMR 1355 MV BETUZABETH ANN 41 UMR 1355 MV BETUZABETH ANN 42 UMR 1350 MV DE LASALLE 41 UMR 1350 MV OENE NEAL 42 UMR 1350 MV GENE NEAL 42 UMR 1350 MV GENE NEAL 42 UMR 1351 MV GENE NEAL 42 UMR		GROUNDING GROUNDING	\$0.00 \$0.00 \$300 00 \$0.00 \$0.00	ART 2458 ART 445 RCC 100		PORT QUARTER PORT QUARTER PORT BOW
MC0860M MC080M MC080M MC080M MC080M MC080M MC080M MC080M MC080M MC080M MC080M MC080M MC080M MC080M MC0		1219 MV COOPERATIVE SPRIT 41 1315 MV ELTZABETH AND 41 UMR 1315 MV BETTY LYNN 41 UMR 1315 MV BETTY LYNN 41 UMR 1310 MV DE LASALLE 41 UMR 1310 MV DE LASALLE 41 UMR 1310 MV DRAIRIE DAWN 42 UMR 1311 MW ANN BREETH 42 UMR 1315 MV GENE NEAL 42 UMR 1345 MV GENE NEAL 42 UMR 1346 MV GENE NEAL 42 UMR 1346 MV GENE NEAL 42 UMR 1347 MV GENE NEAL 42 UMR 1348 MV GENE NEAL 42 UMR 1348 MV GENE NEAL 42 UMR 1348 MV GENE NEAL 42 UMR 1349 MV GENE NEAL 42 UMR 1340 MV GENE NEAL 43 UMR		GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING	\$0.00 \$300.00 \$0.00 10.0	ART 445 RCC 100		PORT QUARTER PORT BOW
MC9807M MC9		1845 IAV ELIZABETH ANN 41 UMR 1856 IAV BELTY LYNH 11 UMR 1800 IAV DE LASALLE 41 UMR 1815 IAV ANN BRENT 42 UMR 1815 IAV GENE NEAL 42 UMR 1845 IAV GENE NEAL 42 UMR 1846 IAV GENE NEAL 43 UMR 1847 IAV GENE NEAL 43 UMR 1848 IAV GENE NEAL 43 UMR 1849 IAV GENE NEAL 43 UMR 1850 IAV GEN		GROUNDING GROUNDING GROUNDING ALLISION GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING	\$300 00 2 \$0.00 1	IRCC 100		PORT BOW
MC9807M MC9		1355 MV BETTY LYKN 4 1 UNR 1800 MV DE LASALLE 11 UNR 1800 MV DE LASALLE 41 UNR 1801 MV AGNE NEAL 42 UNR 1805 MV AGNE NEAL 43 UNR 1805 MV AGNE N		GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING	\$0.00 s			
00980/M 00980/		1900 IAV DE LASALLE 41 UMR 1900 IAV DE LASALLE 41 UMR 1900 IAV DE LASALLE 41 UMR 500 IAV AND BERETT 42 UMR 515 IAV AND BERETT 42 UMR 645 IAV GENE NEAL 42 UMR 646 IAV GENE NEAL 42 UMR 646 IAV GENE NEAL 42 UMR 647 IAV GENE NEAL 42 UMR 648 IAV GENE NEAL 42 UMR 648 IAV GENE NEAL 42 UMR 649 IAV GENE NEAL 42 UMR 640 IAV GENE NEAL 42 UMR 640 IAV GENE NEAL 42 UMR 650 IAV GENE NEAL 43 UMR		GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING GROLINDING	not noted 4	BETTY LYNN	-	STARBOARD MIDSHIP HALF LENGTH
MC980M MC980M		1900 MV OE LASALLE 4 UMRR 200 MV PERARIE DAWN 42 UMR 315 MV GENE BEENT 42 UMR 345 MV GENE BEEN 42 UMR 346 MV GENE BEEN 43 UMR 347 MV GENE BEEN 43 UMR 348 MV GENE BEEN 43 UMR		ALLISION GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING GROUNDING	A profess	OCC 515	-	PORT BOW
00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M		200 MV PRAIRE DAMM 42 UMR 315 MV ANN BRENT 42 UMR 345 MV GENE NEAL 42 UMR 945 MV GENE NEAL 42 UMR 946 MV GENE NEAL 42 UMR 950 MV BILL ANDREWS 33.7 UMR 950 MV BILL ANDREWS 33.7 UMR 950 MV BILL ANDREWS 33.7 UMR			2000	DM 3032	0	STARBOARD BOW
00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M 00980/M		551 MAY ANN BRENT 42 UMR 945 MAY GENE NEAL 22 UMR 945 MAY GENE NEAL 22 UMR 945 MAY GENE NEAL 22 UMR 945 MAY GENE NEAL 42 UMR 950 MAY BLIL ANDREWS 33.7 UMR 960 MAY BLIL ANDREWS 33.7 UMR			\$30,000.00	PRAIRIE DAWN		STARBOARD QUARTER
00580)W 00580)W 00580)W 00580)W 00580)W 00580)W 00580)W 00580)W 00580)W 00580)W 00580)W		945 MV GENE MEAL 42 UMR 945 MV GENE MEAL 42 UMR 945 MV GENE NEAL 42 UMR 946 MV GENE NEAL 42 UMR			\$60,000 00	ANN BRENT		PORT MIDSHIP HALF LENGTH
MC980W 00580W 00580W 00580W 00580W 00580W 00580W 00580W 00580W 00580W		945 M/V GENE NEAL 12 UMR 946 M/V GENE NEAL 12 UMR 946 M/V GENE NEAL 12 UMR 945 M/V GENE NEAL 12 UMR 946 M/V GENE NEAL 12 UMR 946 M/V GENE NEAL 12 UMR 960 M/V BILL ANDREWS 337 UMR 600 M/V BILL ANDREWS 337 UMR 600 M/V BILL ANDREWS 337 UMR 600 M/V BILL ANDREWS 337 UMR			\$253,500 00 12	AARON G	7	NOT NOTED
MC980M MC9800 MC900 MC900 MC900 MC900 MC900 MC900 MC900 MC900 MC900 MC900 MC900 MC900		945 MV GENE NEAL 42 UMR 946 MV GENE NEAL 42 UMR 946 MV GENE NEAL 42 UMR 946 MV GENE NEAL 42 UMR 945 MV GENE NEAL 42 UMR 946 MV GENE NEAL 42 UMR 947 MV GENE NEAL 42 UMR 948 MV GENE NEAL 42 UMR 948 MV GENE NEAL 42 UMR 948 MV GENE NEAL 42 UMR 949 MV GENE NEAL 42 UMR 940 MV GILL ANDREWS 33.7 UMR 960 MV BILL ANDREWS 33.7 UMR			\$253,500,00 12	WRESB	-	NOT NOTED
MC6500M MC6500M MC6500M MC6500M MC6500M MC6500M MC6500M MC6500M MC6500M MC6500M MC6500M MC6500M		945 MV GENE NEAL 4" UMR 945 MV GENE NEAL 4" UMR 946 MV GENE NEAL 4" UMR 946 MV GENE NEAL 4" UMR 960 MV BILL ANDREWS 3.3" UMR 960 MV BILL ANDREWS 3.3" UMR 960 MV BILL ANDREWS 3.3" UMR			_	TAN 42	-	PORT CHARTER
00580/M 00580/M 00580/M 00580/M 00580/M 00580/M 00580/M 00580/M		945 MV GENE NEAL 2 UMR 945 MV GENE NEAL 2 UMR 960 MV BILL ANDREWS 337 UMR 900 MV BILL ANDREWS 337 UM 900 MV BILL ANDREWS 337 UMR			_	THE PERSON NAMED IN		CTADO OLA DIA
00580/M 00580/M 00580/M 00580/M 00580/M 00580/M 00580/M		BAS MAY GENE NEAL & UMR BAS MAY BULL ANDREWS & 3.7 UMI BAS MAY BULL ANDREWS & 3.7 UMI BAS MAY BULL ANDREWS & 3.7 UMR					7 (STANDONNO CONTRACTOR
MC980M MC980D MC		945 MAY GENE NEAL 42 UMR 945 MAY GENE NEAL 42 UMR 960 MAY BILL ANDREWS 337 UMN 600 MAY BILL ANDREWS 337 UMN 600 MAY BILL ANDREWS 337 UMN 600 MAY BILL ANDREWS 337 UMN			21 00:000:0026	GENE NEAL	>	FOR MIDSHIP HALF LENGTH
MC9500W MC9500W MC9500W MC9500W MC9500W		WISH MAY GENE WEAL 42 UMR 945 MAY GENE WEAL 42 UMR 960 MAY GENE WEAL 42 UMR 960 MAY BILL ANDREWS 43.7 UM 860 MAY BILL ANDREWS 43.7 UM 860 MAY BILL ANDREWS 43.7 UMR			_	110 118	2	PORT MIDSHIP HALF LENGTH
MC95001 MC95001 MC95001 MC95001 MC95001		945 MV GENE KEZL 42 UMR 945 MV GENE KEZL 42 UMR 945 MV GENE NEZL 42 UMR 960 MV BILL ANDREWS 33.7 UMR 960 MV BILL ANDREWS 33.7 UMR			_	PV 2918 FL	6	PORT MIDSHIP HALF LENGTH
MC95007 MC95007 MC95007 MC9500		945 MAY GENE HEAL 42 UMR 945 MAY GENE HEAL 42 UMR 945 MAY GENE NEAL 42 UMR 945 MAY GENE NEAL 42 UMR 945 MAY GENE NEAL 42 UMR 950 MAY BILL ANDREWS 43.7 UMR 900 MAY BILL ANDREWS 43.7 UMR			\$253,500.00 12	STFB 36B	2	PORT MIDSHIP HALF LENGTH
MC9500 MC9500		945 IAV GENE NEAL 42 UAR 945 IAV GENE NEAL 42 UAR 945 IAV GENE NEAL 42 UAR 945 IAV GENE NEAL 42 UAR 600 IAV BILL ANDREWS 43.7 UAI 600 IAV BILL ANDREWS 43.7 UAI	_		\$253,500.00 12	DP 273	2	PORT MIDSHIP HALF LENGTH
MC9500		945 MAY GENE NEAL 42 UMR 945 MAY GENE NEAL 42 UMR 945 MAY GENE NEAL 42 UMR 960 MAY BILL ANDREWS 43.7 UM 960 MAY BILL ANDREWS 43.7 UM 960 MAY BILL ANDREWS 43.7 UM			\$253,500.00	F 13	2	PORT MIDSHIP HALF LENGTH
MC8500		945 M/V GENE NEAL 42 UMR 945 M/V GENE NEAL 42 UMR 945 M/V GENE NEAL 42 UMR 940 M/V BILL ANDREWS 43.7 UM 950 M/V BILL ANDREWS 43.7 UM 950 M/V BILL ANDREWS 43.7 UM	-	_	_	C G B 209 B	100	PORT MIDSHIP HALF LENGTH
		945 MV GENE NEAL 42 UMR 600 MV BILL ANDREWS 43.7 UM 900 MV BILL ANDREWS 43.7 UM 600 MV BILL ANDREWS 43.7 UM	_	GROUNDING	_	CGB 339	2	PORT LINSHIP HALFLENGTH
MC95002756		600 M/V BILL ANDREWS 43.7 UM 800 M/V BILL ANDREWS 43.7 UM 800 M/V BILL ANDREWS 43.7 UM	RIVER		_	AGS 033	-	PORT MINSHIP HALF LENGTH
MC97006597		800 MV BILL ANDREWS 43.7 UM 800 MV BILL ANDREWS 43.7 UM	RIVER	_		00.0010	-	DOOT BOW
IACGZOCKE		600 MAY BILL ANDREWS 43.7 UM	Daves -	-	_	CLIN 4De		200 F00 C
ALCOTOCERS.		DON MAY DILL PURCE TO SELECT			_	5000		TOTAL BOTH OF THE PARTY OF THE
D. BOW		The state of the s			_	CCB 2508		SI AKBOAKO GUAKIEK
INCB/1006587		600 MAY BILL ANDREWS				TPC 220		PORT BOW
MC97006597	597 14-May-97	600 MAY BILL ANDREWS 43.7 UM	UPPER MISSISSIPPI RIVER 43	ALLISION	\$99,500 00 25	ABC 404		PORT QUARTER
MC97006597	587 14-May-97	600 MAY BILL ANDREWS 43.7 UMR	UPPER MISSISSIPPI RIVER 43	ALLISION	\$99,500 00 25	ABC 406		STARBOARD BOW
MC97006597		600 M/V BILL ANDREWS		_		CC 95130	_	POPT OF INDICATED
MC97006597	Ċ	800 MAY BILL ANDREWS	RIVER	_	_	CC 05136		STADBOADO CITADATED
MC05500782	Ė	2030 MA AMERICAN PHIL	PIVED		_	ADT 161	,	BOOT BOIL
MCGSCOCO		2030 MAY AMERICAN DII - AD 43 7 11	_		914,320,00	ACO 1368	3 0	STANDONE DOWN
MC9500782		_	Daves		00.000.00	AT 5368		STANDONAL BOWN
10000000000000000000000000000000000000		2030 MAY AMEDICAN DILL AD 43 7 15	20000		00.000,414	9070 1	-	STANBOAND BOW
200000M		3 5	_	_	914,930.00	AL COAD	2	STARBOARD BOW
MCS30A		_	RIVER		8 00.000.00	A1 9/38	n (STARBOARD BOW
20/0000M		AUSO INV. AMERICAN PILLAR 45.7 UMR	RIVER	_	\$14,850.00 8	ARI ASO	n (STARBOARD GUARTER
ZB/OCKOW!		2030 MV AMERICAN FILLAR 43.7 UMR	_	ALLISION	\$14,850.00 8	TCB 319	m	STARBOARD QUARTER
MCSSOGSOMS		905 MV LAINEY JONES 44 UMIR	_	ALLISION	not noted	TPC 101 F	m	PORT BOW
MC95008048	_	905 MV LAINEY JONES 44 UMR	UPPER MISSISSIPPI RIVER 43	ALLISION	not noted 4	LF 521	6	PORT QUARTER
MC95008048	#	905 MV LAINEY JONES 44 UMR	UPPER MISSISSIPPI RIVER 43		to noted 4	GOIU 238	6	STARBOARD BOW
MC95011408	408 13-31年95	500 M/V GIRARD LEWIS 43.7 UMR	UPPER MISSISSIPPI RIVER 43	ALLISION	2 000.000 2	APEX 102X	80	PORT MIDSHIP HALF LENGTH
MC93004002	002 6-Mar-93	1410 ALL: T/B BILL ANDREWS -THEBES	UPPER MISSISSIPPI RIVER 43	ALLISION	\$111,500.00	RBL 5178		STARBOARD BOW
MC93004002	002 6-Mar-93	1410 ALL: T/B BILL ANDREWS -THEBES	UPPER MISSISSIPPI RIVER 43	ALLISION	\$111,500.00	CJB 280		PORT MIDSHIP HALF LENGTH
MC8300401	011 7-Mar-93	445 ALL: MV LAURA TAMBLE -THEBES	UPPER MISSISSIPPI RIVER 43	ALLISION	\$132,400.00	CGB 462B		STARBOARD QUARTER
MC9300401	011 7-Mar-93	445 ALL: MY LAURA TAMBLE -THEBES	UPPER MISSISSIPPI RIVER 43	ALLISION	\$132,400.00	DS 6		STARBOARD QUARTER
MC93004011	_	445 ALL: MV LAURA TAMBLE -THEBES	UPPER MISSISSIPPI RIVER 43	ALLISION	\$132,400.00	DS9		PORT BOW
MC83004011	011 7-Mar-93	445 ALL: MV LAURA TAMBLE -THEBES	UPPER MISSISSIPPI RIVER 43	ALLISION	\$132,400.00	PV 550 FLB		PORT QUARTER
MC93004011	011 7-Mar-93	445 ALL: MY LAURA TAMBLE -THEBES	UPPER MISSISSIPPI RIVER 43	ALLISION	\$132,400.00	ABC 423B		PORT MIDSHIP HALF LENGTH
MC93004011	011 7-Mar-93	445 ALL: MV LAURA TAMBLE -THEBES	UPPER MISSISSIPPI RIVER 43	_	\$132,400.00	ML 7058	_	PORT BOW
MC83004011	011 7-Mar-93	445 ALL: MV LAURA TAMBLE -THEBES	_		\$132 400 00	SCE 122		STARROARD ROW
MC93004011	011 7-Mar-93	445 ALL: MV LAURA TAMBLE -THEBES	_		\$132,400,00	CBI 332		PORT BOW
MC94018298	_	1625 MV K.L.J. ERICKSON 43 UMR	_	COLLISION	NOT NOTED 5	FEC 9228	-	STARBOARD BOW
MC94018299	-	1625 MV K.L.J. ERICKSON 43 UMR		COLLISION	NOT NOTED 6	EFC 9231	-	STARBOARD BOW
MCB4018289	299 1-Sep-94	1625 MV K.L.J. ERICKSON 43 UMR	UPPER MISSISSIPPI RIVER 43	COLLISION	NOT NOTED 5	OLD YELLOW	0	PORTBOW
MC94018299	299 1-Sep-94	1625 MV K.L.J. ERICKSON 43 UMR	UPPER MISSISSIPPI RIVER 43	COLLISION	NOT NOTED 5	EFC 9214	***	PORT QUARTER
MC94003472	472 18-Feb-94	2015 MV BERNARD G 43 UMR	UPPER MISSISSIPPI RIVER 43	GROUNDING	\$16,000.00	CCT 84	4	STARBOARD BOW
MC96015836	836 17-Oct-96	340 MV J.B. KLEINPETER 45 UMR	UPPER MISSISSIPPI RIVER 44	GROUNDING	\$1,000.00	OR 1055		PORT BOW
MC96015536	336 17-Oct-96	340 M/V J.B. KLEINPETER 45 UMR	UPPER MISSISSIPPI RIVER 44	GROUNDING	\$1,000.00	OR 7039		PORT QUARTER
MC96018374			UPPER MISSISSIPPI RIVER 44		\$141,962.00 4	OCC 506		STARBOARD BOW
MC96018374	_	230 M/V MIDWEST VOYAGER 45 UMR	UPPER MISSISSIPPI RIVER 44	GROUNDING	\$141,962.00 4	CGB 131		STARBOARD BOW
MC9500368	364 1-Feb-95	1720 MW W.A. KERNAN 44 UMR	UPPER MISSISSIPPI RIVER 44	GROUNDING	\$5,000.000	W. A. KERNAN		STARBOARD QUARTER

Bendway Weirs	C886	740	51116	Cascripton	the production of the states		and a same of	and			needo	
	MC95013077	13-Aug-95	ь.	2300 M/V TRANSPORTER 44 UMR	UPPER MISSISSIPPI RIVER	44	-	not noted 2	TRANS	IRANSPORTER	0	PORT DUA
	MC95013077	13-Aug-95		2300 MAY TRANSPORTER 44 UMR	UPPER MISSISSIPPI RIVER			not noted 2	H 122 B		· c	PORT ROW
	MC97018083	24-Dec-97		2330 M/V BUTCH BARRAS 45 UMR	UPPER MISSISSIPPI RIVER			\$29,500.00	VL 7530			PORT BOW
	MC97018083	24-Dec-97	2330 M/V BUTCH BARRAS	CH BARRAS 45 UMR	UPPER MISSISSIPPI RIVER	*****	GROUNDING	\$29,500,00	VL 7529			PORT DUARTER
	MC97018083	24-Dec-97	2330 M/V BUT	2330 M/V BUTCH BARRAS 45 UMR	UPPER MISSISSIPPI RIVER	45 G	GROUNDING	\$29,500.00	ACBL 2064	064	••••	PORT BOW
	MC97018083	24-Dec-97	2330 M/V BUT	2330 M/V BUTCH BARRAS 45 UMR	UPPER MISSISSIPPI RIVER		GROUNDING	\$29,500.00	VLX 7370	02	****	STARBOARD CUARTER
	MC96013987	15-Sep-96	215 M/V SHE	215 M/V SHEILA JOHNSON 45 UMR	UPPER MISSISSIPP! RIVER	45	GROUNDING	\$1,200.00	CC 8042	2		PORT BOW
	MC96013987	15-Sep-96	215 M/V SHE	215 M/V SHEILA JOHNSON 45 UMR	UPPER MISSISSIPPI RIVER	45	GROUNDING	\$1,200.00	B-265			PORT BOW
	MC98013987	15-Sep-98	215 MV SHE	215 MAY SHEILA JOHNSON 45 UMR	UPPER MISSISSIPPI RIVER	45	GROUNDING	\$1,200,00	CC-9273			PORT BOW
	MC98013987	15-Sep-98	215 M/V SHE	215 MV SHEILA JOHNSON 45 UMR	UPPER MISSISSIPPI RIVER	6	GROUNDING	\$1,200.00	CC-8051	-	-	PORT BOW
	MC96013987	15-Sap-95	215 M/V SHE	ILA JOHNSON 45 UMR	UPPER MISSISSIPPI RIVER	*****	GROUNDING	\$1,200.00	CC 7801			PORT BOW
	MC94012403	2-May-94	THE VIN DOCC	2200 MAY RITCH RAPRAS AS 19MP	LIPPER MISSISSIPPI BIVER	*****	CHOMING	C 500 00	VI B 75400	90	-	STANDON OUNDERED
	MCGGGGGG	27 Cah 06	1745 44/ DED	1745 446/ DEDNADO G. 48 1840	LIDDER MISSISSIPPI DAVED	******	Chicknoor	446 000 00	DICT VIOLE	200	>	AND CANADA TOOL
	A6C05013434	24 14 06	4246 444/ 10/10	ASAK BOREDT II STOUT AS INCO	COLUMN MICORDINATION OF THE PROPERTY OF THE PR		O WICH TO SE	00'000'010	S C C C C C C C C C C C C C C C C C C C	277 CASC		WORLD WORLD
	WCSDCISC W	CR-Inc-Ic	SAD MIN CPC	SERI N. SI COI 46 UMR	UPPER MISSISSIPPI KIVER		GROUNDING	00.0¢	KOBEK	KOBERT N. STOOT		STARBOARD MIDSHIP HALF LENGTH
	MC95016732	23-Oct-95	1920 MAY RAY	1920 MAY A. ECKSTEIN 46 UMR	UPPER MISSISSIPPI RIVER	8	GROUNDING	\$8,000.00	RAY A.	RAY A. ECKSTEIN	-	STARBOARD MIDSHIP HALF LENGTH
	MC95000100	5-Dec-94	900 MV ARN	900 MV ARNOLD SOBEL 46 UMR	UPPER MISSISSIPPI RIVER	86	GROUNDING	\$0.00	ARNOLI	ARNOLD SOBEL		PORT QUARTER
Cape Bend	MC95019534	17-Dec-95		1230 MAY ARNOLD SOBEL 48 UMR	LIPPER MISSISSIPPI RIVER	8	NOISI DO	598 000 00 5	Vi 7701			WOR GRACERATE
Cana Rand	MCGEOTORIA	17. Day 08		1930 MA ABNOLD SOBEL AR LAND	IDDED MISCHOOLD DIVED		NOISI IOO	8 00 000 909	00000000	900		AND DESCRIPTION OF THE PROPERTY OF THE PROPERT
7.00	200000000000000000000000000000000000000	200	A TOP OUT	OLD SOBEL 40 UML	CTTCT MISSISSIPPI KIVER		CCISION	900,000,000	200	0.25		FOR MICORIF MALT LENGTH
Cape Dend	WCSOCISCS.	CR-200-71	ICSU MAY ARK		UPPER MISSISSIPPI RIVER	_	COLLISION	286,000.00	CC1 110	9		STARBOARD MIDSHIP HALF LENGTH
Cape Bend	MC93021460	26-Nov-93	1810 M/V M.P.	1810 M/V M.PATER/ F.GOODMAN 48 UMR	UPPER MISSISSIPPI RIVER	_	COLLISION	\$23,000.00	PV 2933 FL	35.		PORT BOW
Cape Bend	MC93021480	26-Nov-93	1810 M/V M.PA	ATER/ F.GOODMAN 48 UMR	UPPER MISSISSIPPI RIVER	48 C	COLLISION	\$23,000.00	PV 9924 FL	4 FL		PORT BOW
Cape Bend	MC93021480	28-Nov-93	1810 M/V M.P.A	1810 M/V M.PATER/ F.GOODMAN 48 UMR	UPPER MISSISSIPPI RIVER	84	COLLISION	\$23,000.00	MELINA			STARBOARD BOW
Cape Bend	MC94025508	10-Dec-94	\$230 M/V KAY	1230 M/V KAY A, ECKSTEIN 48 UMR	UPPER MISSISSIPPI RIVER	48	GROUNDING	\$35,000,00	CC7830		4	STARROARD
Cape Bend	MC96011721	5-Aug-98	725 MV FS	725 MALESTER COLLISION	GENERALISSISSIDE RIVER	-	NOISITION	802 000 00	SARA 5.2		. ç	SCO COVCOONTO
Cana Band	MC08011724	K Ann DR	725 MAY 1 203	A STORY TO STORY	I IDDED MICOICCIDO DIVEO		TOTAL POOR	900000000	4444		2 5	AND DECORATE
2000	WC80011/2	on-Bny-o	LED THIV LESS	AZDIMIY LESETE B (COLLISION)	OFFER MISSISSIPPI KIVER		OFFISION	\$83,000.00	MIM DO		2	STARBOARD QUARTER
Cape Bend	MC96011721	Se-Bny-c	725 MIV LESS	LIE B (COLLISION)	UPPER MISSISSIPPI RIVER	-	COLLISION	\$83,000.00	CBX 514	*	0	PORT QUARTER
Cape Bend	MC96011721	5-Aug-96	725 M/V LESI	725 M/V LESLIE B (COLLISION)	UPPER MISSISSIPPI RIVER	8	COLLISION	\$93,000.00	ET 805B	er.	10	STARBOARD BOW
Cape Band	MC96007901	28-May-96	1915 M/V GEO	DRGE KING 51 UMR	UPPER MISSISSIPPI RIVER	50	GROUNDING	\$156 555 00 4	GHORG	GEORGE KING		WICH COACHOSTS
Cane Rend	\$1000000000000000000000000000000000000	28.8401.08	4045 MAY GEO	TOTAL MAY CHOOSE WIND RATERED	Does Alecicensis page		ON ON ON	8450 665 00		Ser rough		AND DEVELOPED IN
7000	100000000	De vernay	DED AND CLOS	THE NIME OF CHAIR	OFFER MISSISSIPPI RIVER		SUCUSION OF	\$100,000,001¢	NA C X	· ·		STARBOARD BOW
Cape Bend	MC96007901	28-May-96	1915 MV GEORGE KING	ORGE KING 51 UMR	UPPER MISSISSIPPI RIVER		GROUNDING	\$156,555.00 4	CC-7985	ıø.	*****	STARBOARD BOW
Cape Bend	MC96007901	28-May-96	1915 M/V GEORGE KING	DRGE KING 51 UMR	UPPER MISSISSIPPI RIVER	S S	GROUNDING	\$156,555.00 4	CC8275			STARBOARD BOW
	MC94008561	30-Apr-84	130 M/V JAM	130 MV JAMES H, CAREY 50 UMR	UPPER MISSISSIPPI RIVER	8	GROUNDING	\$25,000,00	PL 151		0	STARBOARD BOW
	MC96007367	18-May-96	515 MV BILL	515 MAY BILL O'DONELY 51.8 UMR	UPPER MISSISSIPPI RIVER		AS I ISION	\$30,000,00	RIII	RILL OTHORNEY		Caronica
	MC96007367	18-May-86	515 MV Bil.	O'DONFLY 51.8 UMR	I IPPER MISSISSIPPI RIVER	84 A	MOISITIA	\$20,000,00	MCC 902	5		UTOWN I RIVE GILDOUIS CONCOUNTS
	MCGROTTAT	18.May.DR		O'COME V ST & LINE	LIDDED ANCESCODES DAVED		ACI ICION	# 50 000 00 #	-	£ 7		ON THE PROPERTY OF THE PERSON
	400000000000000000000000000000000000000	de blos 07		March 2000 12 12 12 12 12 12 12 12 12 12 12 12 12		-	100000	430,000,00				מושעקיים מכת
	MC91010290	TO ACCOUNT			UPPER MISSISSIPPI RIVER	-	COLLISION	\$16,000.00	25.5	CURTIS MOORE		SIARBOARD QUARTER
	MC97016296	15-Nov-87			UPPER MISSISSIPPI RIVER		COLLISION	\$18,000.00	STC0 1001	1001		PORT QUARTER
	MC97016296	15-Nov-97		TIS MOORE 51 UMR	UPPER MISSISSIPPI RIVER	2	COLLISION	\$18,000.00	STC0 2303	303		STARBOARD QUARTER
	MC93005827	1-Anr-93		2	STATE MISSISSIDE BIVER		EOUID EAN	#300 000 00 T	DIAL DRA			OUTOWING CONCORDED
	MC0200K827	Anr 03		201-03-04 C 201-03-03-03-03-03-03-03-03-03-03-03-03-03-	LIBORIO ANDORRO DEL CALCADA		TO CO CO CO	\$ 00.000,000	DY V 20		? .	THE WAY OF THE PERSON OF THE P
	140000000000000000000000000000000000000	200		- 10000 - 100000 - 10000 - 10000 - 10000 - 10000 - 10000 - 10000 - 10000 - 100000 - 10000 - 10000 - 10000 - 10000 - 10000 - 10000 - 10000 - 10	OFTEN MISSISSIPPI NIVER		THE STATE OF THE S	900000000	KAV ZO		,	め とればいるという いっちょうにん
	MCSSUDSET	-Apr-83		TROOM WAY A MICKELLIN	UPPER MISSISSIPPI RIVER		EQUIP FAIL	\$380,000.00	JT 38		0	STARBOARD QUARTER
	MC93009827	1-Apr-93		2	UPPER MISSISSIPPI RIVER	-	EQUIP FAIL	\$390,000.00	JT 38		60	PORT MIDSHIP HALF LENGTH
	MC97006107	5-May-97		CONO 51, UMR	UPPER MISSISSIPPI RIVER	5 0	GROUNDING	\$10,000.00	B-1224		0	STARBOARD MIDSHIP HALF LENGTH
Cape Rock	MC97001115	20~Jan-97	4=	1310 M/V MIDWEST EXPLORER MI 53 UMR	UPPER MISSISSIPPI RIVER	53	GROUNDING	\$1,000.00	BUNGE 85	92	10	PORTBOW
Cape Rock	MC94016179	6-Aug-94			UPPER MISSISSIPPI RIVER		CROMONO	CUU US	ACS SOA	-		AC a La Ca
Cape Rock	MC94019525	TA. Son. 94		HALL MADTIN AS A IND	I IDOED MICCISCIDDI DIVED		CONCINIONO	62 000 000		CO CTA1 2026 1	4 0	100 H
Cape Book	340.07001479	10 000	010 111 010	STORY OF DAYER DAYER AND	TODAC PROCESSED OF THE PARTY OF			92,000.00		רב בטבטינ. היים		TON BOW
TOOK O	MCS1001412	10-11R-01		האים האינוע הוועאים האינו	UPPER MISSISSIPPI KIVER		SKOONDING	20.00	ACEL 2018	016	_	NOT NOTED
Cape Rock	MCSOCOODS	14~an-80	_	1615 M/V OKLEANIAN 54 UMK	UPPER MISSISSIPPI RIVER		GROUNDING	\$0.00	SER 165	ú)	2	STARBOARD BOW
Cape Rock	MC96002415	9-Feb-96		730 MV ALTONIAN 55.2 UMR	UPPER MISSISSIPPI RIVER	22	BREAKAWAY	\$75,000.00	PV 2947	-		STARBOARD MIDSHIP HALF LENGTH
Picavune	MC94010709	19-Jan-94		1010 MAY KEVIN TOLEN GRAD 56 9 DAIR	LIPPER MISSISSIPPI RIVER		CROHNING	A 00 02	RINGE R7	87		NOT NOTED
Dicavina	MC04010700	10. lon. D.		AND AND TO THE COMP AND THE	LIGOGES ARECTOCIONIS DAVES		Chambridge	00.00				
June	4004040700	40 101 04		THE POST OF THE PO	MISSISSIFFI MISSISSIFFI MINER	_	COUNTRIES	90.00	CONCE OF	90		NO. NO.
reayone	MCS4010/03	18-001-81		TOTO MAY REVIN LOLEN, GRAD, 56.9 UMR	UPPER MISSISSIPPI RIVER		GROUNDING	\$0.00	BUNGE 682	. 682		NOT NOTED
	MC94004986	10-Mar-94	_	1105 UMR 60.0 M/V J. RUSSEL FLOWERS	UPPER MISSISSIPPI RIVER		EQUIP FAIL	\$98,000.00 2	J. RUSS	J. RUSSELL FLOWERS		PORT QUARTER
	MC94004986	10-Mar-94		1105 UMR 60.0 M/V J. RUSSEL FLOWERS	UPPER MISSISSIPPI RIVER	8	EQUIP FAIL	\$98,000.00	ACBL 3014	014		PORT QUARTER
	MC96006185	7-Feb-96	_	1300 NOBLE C. PARSONAGE (SLMMS)	UPPER MISSISSIPPI RIVER	8	GROUNDING	not noted 1	NOBLE	NOBLE C. PARSONAGE		NOT NOTED
	MC96001091	2-Jan-98	1040	CONTI SUSAN (SLMMS)	UPPER MISSISSIPPI RIVER	88		and noted 4	CONTISHSAN	SIISAN		STARROARD ROW
	MC97007891	1-Jun-97	_	2255 JUDIVER OLIMP (STAMMS)	LIPPER MISSISSIPPI RIVER			the protoci	2			NOT NOTED
	MC9500664B	20-Anr-95	•	NA ME STATE	GEVIE MISSISSIDE BIVED		CONTINUO	\$ 000 000 E	CHORE	Charles of Atte		OH TOTAL
	AACOSONGE AB	20 Apr. 05		NAME OF ATE	CIDDED MICCIOCOD DIVED		CANCINCOL	200,000,000	and on	ME OLY II		NO NO ED
	ghoonneanw.	CR-104-07		AV ME OLAIE	OFFER MISSISSIPPI KIVEK		GROUNDING	285,000.00	CC 8287			STARBOARD BOW
	MC9500b648	CG-Jdb-07		2300 M/V SHOW ME STATE	UPPER MISSISSIPPI RIVER	92	GROUNDING	\$85,000.00	DM 1314	4		STARBOARD BOW
	MC95006648	20-Ang-95		THE STATE	Control tale of control of the control							
		-		A ME OLA IE	CLYCK MISSISSIFF KIVER	28 28	GROUNDING	\$85,000.00	AGR! 8061	361		STARBOARD BOW

Bendway Weirs	Case		Time Description	Waterway	Mile	Incident Type	Darmage Ves		Sp	Speed	Damage Location
	MC98017970	S-Dec-86	516 KAY A. ECKSTEIN (SLMMS)	UPPER MISSISSIPPI RIVER	14	z	not noted	KAY A ECKSTEIN			NOT NOTED
	MC97010954	20-Jul-97	430 S/R ST. LOUIS/78UMR (SLMMS)	UPPER MISSISSIPPI RIVER			not noted	SVR ST LOUIS		12	PORT QUARTER
	MCMOI 2251	0-Vii0-80	225 BILL SIEGBAUER/RIIA BARIA(SIL)	UPPER MISSISSIPPI RIVER	2 8	COLLISION	not noted	HMS 280		o c	STARBOARD QUARTER
Fountain Bluff	MC96001835	23-Jan-96	635 MIDWEST EXPLORER (SLIMMS)	UPPER MISSISSIPPI RIVER	_		not noted	MIDWEST EXPLORED		2. 2	NOT NOTED
Fountain Bluff	MC85006735	20-Apr-95	30 MAY FLOYD GOODMAN	UPPER MISSISSIPPI RIVER	_	. 5	\$747,500,00	CB 41		6	PORT ROW
Fountain Bluff	MC95006735	20-Apr-95	30 M/V FLOYD GOODMAN	UPPER MISSISSIPPI RIVER		GROUNDING	\$747,500.00 19	_	***	<u>a</u>	PORT BOW
Fountain Bluff	MC95006735	20-Apr-05	30 MAY FLOYD GOODMAN	UPPER MISSISSIPPI RIVER	_	GROUNDING	\$747,500.00 19			4	PORT BOW
Fountain Bluff	MC95008735	20-Apr-95	30 MV FLOYD GOODMAN	UPPER MISSISSIPPI RIVER	_	GROUNDING	_			ă.	PORT BOW
Foundarin Bladf	MC95006/35	ZO-Apr-83	30 MAY FLOYD GOODMAN	UPPER MISSISSIPPI RIVER		GROUNDING		-		α, α	PORT BOW
Countries Bloff	MC65006736	20.00	SOURCE COOPERS	UPTER MISSISSIPPI KIVER		GROUNDING		-		2 (POKE BOW
Fountain Bluff	MC95006735	20.401.05	SO MAY ELOYO GOODBAN	UPPER MISSISSIPPI RIVER	3 6	GROUNDING	27,7200.00	501 100		1	PORT GUARTER
Fountain Bluk	MC95006735	20 Anc. 05	SOLINA ELOYD GOODBABN	LIDDED MISSISSIPPI RIVER	-	GROUNDING	\$747,500.00 18	•		1 6	POKI MIDSHIP MALE LENGTH
Fountain Bluff	MC95008735	20-Apr.06	SOLITON ELOYD GOODWAN	HOPER MISSISSIBEI BIVER	-	SPICINI COS	_	`			PORT MIDSHIP TALF LENGTH
Fountain Bluff	MC95008735	20 Apr. 95	SOLAN FLOYD GOODWAN	I IDDEE MISSISSIDE BIVED	_	SPICINOWS SECTIONS	6747 500.00	000.2040		Ld	PORT MICSAIL TALK LENGTH
Fountain Bluff	MC95006735	20-Apr-95	30 MV FLOYD GOODMAN	UPPER MISSISSIPPI RIVER	_	GROUNDING	2747 500 001	ABC 755		Lā	PORT MIDSHIP HALF LENGTH
Fountain Bluff	MC95006735	20-Apr-95	30 MAY FLOYD GOODMAN	UPPER MISSISSIPPI RIVER	_	GROUNDING	\$747.500.00	847.160		. 6	PORT MIDSHIP HALF I FINGTH
Fountain Bluff	MC95008735	20-Apr-95	30 M/V FLOYD GOODMAN	UPPER MISSISSIPPI RIVER	_	GROUNDING	\$747,500.00	ABC 417		. &	PORT MIDSHIP HALF LENGTH
Fountain Bluff	MC95006735	20-Apr-95	30 M/V FLOYD GOODMAN	UPPER MISSISSIPPI RIVER	8	GROUNDING	\$747,500.00 19			(n	STARBOARD MIDSHIP HALF LENGTH
Fountain Bluff	MC95009546		2000 MV ROBERT GREENE	UPPER MISSISSIPPI RIVER	8	GROUNDING	\$22,500.00	ROBERT GREENE		ž	NOT NOTED
Fountain Stuff	MC95000183	10-Dec-94	BOO MAY LOUIS H. MEECE	UPPER MISSISSIPPI RIVER	_	GROUNDING	\$10,000.00	ACBL 1272	_	<u>a.</u>	PORT BOW
Fountain Bluff	MC95000193	10-Dec-94	600 MV LOUIS H. MEECE	UPPER MISSISSIPPI RIVER			\$10,000.00	ACBL 2881			PORT BOW
Podnam Ban	MCS0010958	-	346 INSLE TOLEN-1/8 OCC 314(SLMMS)	UPPER MISSISSIPPI RIVER			not noted 2	INGLE L. TOLEN	_	Ž i	NOT NOTED
Red Rock	MC85018656	-		UPPER MISSISSIPPI RIVER		o .	\$1,000.00	PC 2805	_	so:	STARBOARD MIDSHIP HALF LENGTH
Red Rock	MCSGOOGARR	18-Mar-96	AN MAN TRANSPORTER (SUMMS)	I I I I I I I I I I I I I I I I I I I	1 9	EQUIP PAIL	not noted	CC 5130		Ž	NOT NOTED
Red Rock	MC96004488	16-Mar-96	45 MV TRANSPORTER (SLMMS)	LIPPER MISSISSIPPI RIVER			not not and	CC-8120		žž	NOT NOTED
Red Rock	MC97001847	18-Jan-97	2130 SANDY N'CONTLUDIASUMR(SLAMS)	UPPER MISSISSIPPI RIVER	8 2		not moted	MAV CONTI JUDI		Ž	NOT NOTED
Red Rock	MC97001847		2130 SANDY N'CONTIJUDI/85UMR(SLMMS)	UPPER MISSISSIPPI RIVER	_		not noted	VLB 9174		ă	PORT QUARTER
Red Rock	MC97001847		2130 SANDY INCONTIJUDI/85UMR(SLMMS)	UPPER MISSISSIPPI RIVER	-		4 peton ton	AGS 914		ď	PORT QUARTER
Red Rock	MC96006604		1130 MAY LAINEY JONES (SLMMS)	UPPER MISSISSIPPI RIVER			not noted 2	PJ123		ž	NOT NOTED
	MC95009072	20-08-1-0	1345 MV J. ANDREW ECKSTEIN	UPPER MISSISSIPPI RIVER	-	_	not noted	J ANDREW ECKSTEIN		S	STARBOARD MIDSHIP HALF LENGTH
	MC93003035		300 ALOIS LUHR ALLISION 109 5 UMR	LIPPER MISSISSIPPI RIVER	9 8	GROUNDING	\$2,500.00 \$48,160.00	1 921		ט מ	STARBOARD MIDSHIP HALF LENGTH
	MC93003035	16-Jan-93	300 ALOIS LUHR, ALLISION 100.5 UMR	UPPER MISSISSIPPI RIVER	_	ALLISION	\$46,160.00	1.977	_	o va	STARBOARD BOW
	MC83003035	16-Jan-83	300 ALOIS LUHR, ALLISION 109.5 UMR	UPPER MISSISSIPPI RIVER		ALLISION	\$48,160.00	L-1001		S	STARBOARD BOW
	MC93003035	16-Jan-93	300 ALOIS LUHR, ALLISION 109.5 UMR	UPPER MISSISSIPPI RIVER		ALLISION	\$48,160.00 6	GD 90\$		2	PORT BOW
	MC93003035		300 ALOIS LUHR, ALLISION 109.5 UMR	UPPER MISSISSIPPI RIVER	_		\$48,160.00 6		1169	<u>x</u>	PORT QUARTER
	MC96017884	90000	1635 KEVIN TOLEN (SLAMS)	UPPER MISSISSIPPI RIVER			not noted 5	AF 13		2 :	PORT QUARTER
	MC94023556	_	830 MAZEUS	LIPPER MISSISSIPPI RIVER	3 5	GROUNDING	NOT NOTED 2	STOO 181 B		n d	STAKBOARD BOW
Kaskaskia	MC96008212		1235 RAY A. ECKSTEIN (SLAMS)	UPPER MISSISSIPPI RIVER			\$600,000,00	_	_	(<u>a</u>	PORT BOW
Kaskaskia	MC94010707		MV KATHY ELLEN GRND, 116.9	UPPER MISSISSIPPI RIVER		GROUNDING	_	_		ž	NOT NOTED
Kaskaskia	MC94010707		1405 MAY KATHY ELLEN GRND,116.9 UMR	UPPER MISSISSIPPI RIVER		GROUNDING	\$0.00	NOMA 310B		ž	NOT NOTED
ABSK 85KIB	MC94010/0/	17. Jan. 94	1405 MAY KATHY ELLEN GRND, 116.9 UMR	UPPER MISSISSIPPI RIVER		GROUNDING	80.00	AGS 6768		ž	NOT NOTED
	MC93000624		1030 MAY BILL STAPP EQUIP/COL/GRD	UPPER MISSISSIPPI RIVER	155	FOUR FAIL	224 100 00	ACO 1328		ח ע	STARBOARD MIDSHIP HALF LENGTH
	MC94004519	_	1651 MAY BILL ELMER GRNDG UMR 145	UPPER MISSISSIPPI RIVER	_	GROUNDING	\$0.00	ACBL 301	•	, a	PORT QUARTER
	MC94004519		1651 M/V BILL ELMER GRNDG UMR 145	UPPER MISSISSIPPI RIVER	145 GR	GROUNDING	\$0.00	AR 803		2	PORT BOW
	MC95009456	_	530 MV BOB STITH	UPPER MISSISSIPPI RIVER	_		not noted 2	вов эттн		ž	NOT NOTED
Card Base	MCM0166/	4 Most 96	600 T/B NO. N.M.S. 1952 (SLMMS)	UPPER MISSISSIPPI RIVER		BREAKAWAY	not noted 1	N.M.S. NO. 1952			NOT NOTED
			200 MV TRIPPERUB BRIDGE	UPPER MISSISSIPPI RIVER	4 4 A		not noted 2	CLYDESDALE	4 \$	2 2 2	STARBOARD QUARTER
	_	21-May-95	200 MV TRIPPER & MV SENATOR SAM	UPPER MISSISSIPPI RIVER	-		not noted 8	TRIPPER	_		PORT BOW
	MC95019155	2-Dec-95	330 KEVIN TOLEN	UPPER MISSISSIPPI RIVER	-		\$5,000.00	CHEM 39		2	PORT MIDSHIP HALF LENGTH
	MC97005723	12-Apr-97	540 HARBOR HUSTLER/170UMR (SLMMS)	UPPER MISSISSIPPI RIVER	2 2	GROUNDING	\$12,500.00 2	RCC 100		ž	NOT NOTED
	_		530 80 BARGES ADRIFT, MI 171.5 UMR	_			NOT NOTED 9	RW 242		2 2	PORT BOW
			530 80 BARGES ADRIFT, MI 171.5 UMR	_	_		NOT NOTED 9	RW 251		8	PORT BOW
				UPPER MISSISSIPPI RIVER	171 BR		NOT NOTED 9	8-251		2	PORT BOW
	MC83008438	4-May-93	030/80 BARGES AURIFT, MI 171.5 UMR	UPPER MISSISSIPPI RIVER	171 BR	BREAKAWAY	NOT NOTED 9	B-270		2	PORT QUARTER

Bendway Weirs	2000	- Anna			Waterway	Wile	Incident 1ype	DAIMAGE		Vessel rathe	20000	
	MC93008458	14-May-93	230		UPPER MISSISSIPPI RIVER	171	BREAKAWAY	NOT NOTED		CC-8040		STARBOAF
	MC93008458	14-May-93	230	80 BARGES ADRIFT, MI 171.5	UPPER MISSISSIPPI RIVER		BREAKAWAY	NOT NOTED		RM 508		PORT BOW
	MC93008458	14-May-93	230	80 BARGES ADRIFT, MI 171.5	UPPER MISSISSIPPI RIVER		BREAKAWAY	NOT NOTED	<u>ი</u>	CC-9220		PORT BOW
	MC93008458	14-May-93	530	80 BARGES ADRIFT, MI 171.5 UMR	UPPER MISSISSIPPI RIVER		BREAKAWAY	NOT NOTED	o e	CC 8017		PORT MIDSHIP HALF LENGTH
	MC83008436	19-May-62	200	930 BU BARGES ADRIFT, MI 1713 UMK	UPPER MISSISSIPPI RIVER	5 6	BREAKAWAY	NOT NOTED	<u>ن</u> د	CC 8026		STARBOARD MIDSHIP HALF LENGTH
	MC97013306	12-San-97	4	440 KAREN MICHELLE 17 10MR (SLMMS)	LIPPER MISSISSIPPI RIVER		FOLISP FAIL	\$9,544.00	0 4	WE FO		NOTING
	MC97013308	12-Sep-97	4	KAREN MICHELLE/171 (MR (S) MMS)	HIPPER MISSISSIPPI RIVER		FOLIP FAIL	\$0 544 00	2	VICKSB118C	_	NOT NOTED
	MC97013308	12-Sep-97	440	440 KAREN MICHELLE/171UMR (SLMMS)	UPPER MISSISSIPPI RIVER		EQUIP FAIL	\$9.544.00	3	WARREND		NOT NOTED
	MC97009919	4-Jul-97	2248	2248 P/C DEATH (2) 171.5UMR (SLMMS)	UPPER MISSISSIPPI RIVER		PERSON CAS	\$2,000.00	3	ERC08454J889		PORT BOW
	MC93000481	4-Jan-93	2030	2030 ANDREA LEIGH, COL. MI 172 UMR	UPPER MISSISSIPPI RIVER	172	ALLISION	\$21,700.00	× ×	AT 44		NOT NOTED
	MC83000481	4~Jan-93	2030	2030 ANDREA LEIGH, COL, MI 172 UMR	UPPER MISSISSIPPI RIVER		ALLISION	\$21,700.00	<u>ق</u>	CC 9208		NOT NOTED
	MC83004398	12-Mar-93	2300	2300 DONALD CARGILL MCMILLIAN 172UM	UPPER MISSISSIPPI RIVER	172	ALLISION	\$61,000,00	I ~	HUGH C. BLASKE		STARBOARD BOW
	MC93004398	12-Mar-93	2300	2300 DONALD CARGILL MCMILLIAN 172UM	UPPER MISSISSIPPI RIVER		ALLISION	\$61,000,00	P.	R. W. NAYE		STARBOARD MIDSHIP HALF LENGTH
	MC93004398	12-Mar-93	2300	2300 DONALD CARGILL MCMILLIAN 172UM	UPPER MISSISSIPPI RIVER	172	ALLISION	\$61,000.00	×	AT 603B		STARBOARD MIDSHIP HALF LENGTH
	MC93004398	12-Mar-93	2300		UPPER MISSISSIPPI RIVER	-	ALLISION	\$61,000.00	7 TE	TOM FRAZIER		STARBOARD BOW
	MC93004398	12-Mar-93	2300	2300 DONALD CARGILL MCMILLIAN 172UM	UPPER MISSISSIPPI RIVER		ALLISION	\$61,000,00	7	ART 505		STARBOARD OLIARTER
	MC93004398	12-Mar-93	2300	DONALD CARGILL MCMILLIAN	UPPER MISSISSIPPI RIVER		ALLISION	\$61,000,00	7	DAVID STEGBAUER		PORT QUARTER
	MC93004400	13-Mar-93	800	800 RANDY ECKSTEIN, ALLI, 172 UMR	UPPER MISSISSIPPI RIVER	_	ALLISION	\$101,000,00	0	RW 240		PORT BOW
,	MC93004400	13-Mar-93	800	800 RANDY ECKSTEIN, ALLI, 172 UMR	UPPER MISSISSIPPI RIVER		ALLISION	\$101,000,00	7	SANDY ECKSTEIN		STARBOARD MIDSHIP HAIF I FINGTH
	MC93004400	13-Mar-93	800	RANDY ECKSTEIN, ALLI, 172 UMR	UPPER MISSISSIPPI RIVER	172	ALLISION	\$101,000.00	1	RIV 187		STARBOARD OUARTER
	MC93004400	13-Mar-93	800	RANDY ECKSTEIN, ALLI, 172 UMR	UPPER MISSISSIPPI RIVER	_	ALLISION	\$101,000,00	1	1 3074		STARBOARD BOW
	MC93004400	13-Mar-93	800	800 RANDY ECKSTEIN, ALLI, 172 UMR	UPPER MISSISSIPPI RIVER	_	ALLISION	\$101,000.00	0	CC-8054		PORT BOW
	MC93004400	13-Mar-93	800	RANDY ECKSTEIN, ALLI, 172 UMR	UPPER MISSISSIPPI RIVER	172	ALLISION	\$101,000,00	7	RW 8348		NOT NOTED
	MC93004400	13-Mar-93	800	800 RANDY ECKSTEIN, ALLI, 172 UMR	UPPER MISSISSIPPI RIVER	-	ALLISION	\$101,000.00	Ď.	CC 7908		PORT BOW
	MC97001496	11-Jan-97	1435	1435 HORNET&MIDWEST LEGEND/172 UMR	UPPER MISSISSIPPI RIVER	172	COLLISION	not noted	7	HORNET		STARBOARD QUARTER
	MC95019300	8-34-95	2300	2300 M/V PHOEBE MERCER	UPPER MISSISSIPPI RIVER	172	COLLISION	\$100.00	<u>a.</u>	PHOEBE MERCER		STARBOARD QUARTER
	MC96014587	19-Sep-96	1535	1535 PAUL MIDDLETON (SLMMS)	UPPER MISSISSIPPI RIVER	172	EQUIP FAIL	not noted	e e	PAUL MIDDLETON		NOT NOTED
	MC95018303	9-Oct-95	1115	1115 SENATOR SAM/INLAND OIL FLEET	UPPER MISSISSIPPI RIVER	173	ALLISION	\$69.000.00		T 3023		STARBOARD BOW
	MC95016303	9-Oct-95	1115	1115 SENATOR SAM/INLAND OIL FLEET	UPPER MISSISSIPPI RIVER		ALLISION	\$69,000,00	00	SENATOR SAM	_	STARBOARD BOW
	MC95013751	14-Apr-95	300	300 M/V WM C. NORMAN COL 173.6 UMR	UPPER MISSISSIPPI RIVER		COLLISION	not noted	<u>×</u>	WILLIAM C. NORMAN		PORT OUARTER
Bellerive	MC97002114	23-Jan-97	1500	1500 DELMAR JAEGER/174 UMR (SLMMS)	UPPER MISSISSIPPI RIVER	174	GROUNDING	not noted	0	DELMAR JAEGER	2	STARBOARD QUARTER
	MC93007510	22-Apr-93	1800	1800 BARGE RW 213, BREAKAWAY	UPPER MISSISSIPPI RIVER	176	BREAKAWAY	\$2,500.00	<u> </u>	RW 213		PORT QUARTER
	MC96008959	26-May-96	245	NAVIGATOR (SLMMS)	UPPER MISSISSIPPI RIVER	_	ALLISION	\$30,000.00	<u>z</u>	NAVIGATOR		PORT BOW
	MC97007642	2-Jun-97	400	400 F/B RRS 7944/BARTON ST (SLMMS)	UPPER MISSISSIPPI RIVER		BREAKAWAY	not noted	~	RRS 7944		PORT MIDSHIP HALF LENGTH
	MC95018006	8-Jun-85	300	300 KATHLEEN PATER (SLMMS)	UPPER MISSISSIPPI RIVER		COLLISION	not noted	~ ×	KATHLEEN PATER		NOT NOTED
	MC97003230	1-Mar-97	\$	1344 MARY BURKE/177UMR(SLMMS)	UPPER MISSISSIPPI RIVER	177	SINKING	\$400,000.00	2	MARY BURKE		NOT NOTED
	MC96007393	16-May-98	2000	2000 VALLEY SUNSHINE (SLMMS)	UPPER MISSISSIPPI RIVER		SINKING	\$350,000.00	2	VALLEY SUNSHINE		STARBOARD MIDSHIP HALF LENGTH
	MC96007393	16-May-96	2000	2000 VALLEY SUNSHINE (SLMMS)	UPPER MISSISSIPPI RIVER		SINKING	\$350,000.00	2	CB 44		STARBOARD BOW
	MC98007024	12-May-96	1743	1743 EAGLE FLEET BREAKAWAY (SLMMS)	UPPER MISSISSIPPI RIVER	_	BREAKAWAY	\$65,000.00	=	CCT-28		PORT BOW
	MC97016031	8-Nov-97	2100	2100 MCCANN DEATH/178 UMR (SLMMS)	UPPER MISSISSIPPI RIVER	_	PERSON CAS	not noted	e e	AGS 941	0	NOT NOTED
	MCS/U16U31	A-Nov-9	3 5	ZIOOMCCANN DEATH/178 UMR (SLMMS)	UPPER MISSISSIPPI RIVER		PERSON CAS	not noted	es (RF 105		NOT NOTED
	MCB/002576	16-de27	177	1121 CLYDESDALE/179.ZUMR(SLMMS)	UPPER MISSISSIPPI RIVER	_	ALLISION	not noted	N :	CLYDESDALE	0 !	PORT BOW
	MCSGCGSSG	Ca-Mbi-ac	240	2340 DEBASEV N. DOCK BARACIAN BARDER IN	UPPER MISSISSIPPI KIVER	2 (ALLISION	not noted	≥ i	MISSISSIPPI DUEEN	÷ .	PORT MIDSHIP HALF LENGTH
	34005005054	K.May.04	200	ADDIANA DORT V. DOUR BRANT TO DESCRIPTION OF THE PROPERTY OF T	I DOED MISSISSIPPI MIVER		AT LICION	SOUTH ACT AND TEN	- 6	1135428	n	STANSCAKU MIDSHIP HALF LENGTH
	MC95005051	S-May 04	9 6	DOMAN ROBT Y LOVE ALL M 180 LIME	HODER MISSISSIDE BIVED		AFLISION	NOT NOTED	* *	NOBER 1. LOVE		PORT MIDSON MACE LENGTO
	MC95005051	5-May-94	9	100 M/V ROBT Y LOVE, ALL M 180 UMR	UPPER MISSISSIPPI RIVER		ALLISION	NOT NOTED	. A	MANA B		PORT MINSHIP HAIR FIRNGTH
	MC93022154	29-Sep-93	2330	2330 PAT BREAN ALLISION EADS BRDG	UPPER MISSISSIPPI RIVER		ALLISION	\$32,000,00	2	ACBL 4049		NOT NOTED
	MC94008835	5-May-94	100	100 ROBERT T.LOVE/EADSBRIDGE180UMR	UPPER MISSISSIPPI RIVER		POLLUTION	NOT NOTED	*	ROBERT Y LOVE	\$	PORT QUARTER
	MC96002316	23~Jan-96	1430	1430 F/B HANNABELLE (SLMMS)	UPPER MISSISSIPPI RIVER		BREAKAWAY	not noted	<u> </u>	HANNABELLE		PORT BOW
	MC96018935	25-Dec-96	638		UPPER MISSISSIPPI RIVER	_	GROUNDING	not noted	2	DELMAR JAEGER	so	NOT NOTED
	MC98000803	24-Dec-97	745	745 HARBOR HUSTLER/182UMR (SLMMS)	UPPER MISSISSIPPI RIVER		GROUNDING	not noted	2	SC 1903	69	PORT BOW
	MCS/013727	13-Sep-97	3 6	JUCUINALY P/183UMR (SLAME)	UPPER MISSISSIPPI RIVER	2 5	ALLISION	\$10,000.00	0 0	CC-7835		STARBOARD QUARTER
	MC97013727	13-Sep-97	1000	1000 KATY P/183 IMR (SLMMS)	I IPPER MISSISSIPPI RIVER	_	AL ISION	\$10,000.00	9 4	AP 848		STANDONNO CONTIEN
	MC95017487	4-Nov-95	1430	1430 GREENVILLE/ALL W/MERCHANT BRI	UPPER MISSISSIPPI RIVER	_	ALLISION	not noted	4	GREENVILLE		STARBOARD BOW
	MC95017724	10-Nov-95	1045	1045 M/V PRECURSOR	UPPER MISSISSIPPI RIVER	_	ALLISION	\$90,600.00	2	COASTAL 2522		PORT BOW
	MC95017724	10-Nov-95	1045	1045 M/V PRECURSOR	UPPER MISSISSIPPI RIVER		ALLISION	\$90,600.00	7	IB 1806		PORT MIDSHIP HALF LENGTH
	MC95017724	10-Nov-95	1045	1045IMV PRECURSOR	UPPER MISSISSIPPI RIVER	183	ALLISION	\$90,600,001	-	IR 1805	_	STARROAD MINSHIP HALF LENGTH
						_	A COMPANIANT OF THE PARIS OF TH	-		2001 01		משום בישם שונים ושום מערים בישם

Bendway Weirs	Case	Date Time	Time Description	Waterway	S S	Mile Incident Type	Damage Ves	* Vessel Name	8	Speed	Damage Location
	MC95020048	19-Dec-95	930 MISS JAN (SLAMS)	UPPER MISSISSIPPI RIVER	183	183 ALLISION	\$110,000.00	MISS JAN			NOT NOTED
	MC94025484	7-Dec-94	300 M/V VIRGINIA ELLISON ALLISION	UPPER MISSISSIPPI RIVER	183	ALLISION	\$25,000.00	COASTAL 2022-T	_	(2)	STARBOARD BOW
	MC95018793	29-Nov-95	30 MV TOM MCCONNELL	UPPER MISSISSIPPI RIVER	183	GROUNDING	\$0.00	BUNGE 407		40	STARBOARD BOW
	MC95019154	9-Nov-95	1810 CAROL ANN PARSONAGE (SLMMS)	UPPER MISSISSIPPI RIVER	181	COLLISION	\$75,000.00	MEM 7834		80	PORT BOW
	MC95019154	9-Nov-85	1810 CAROL ANN PARSONAGE (SLMMS)	UPPER MISSISSIPPI RIVER	2	COLLISION	\$75,000.00	ACBL 308			PORT BOW
	MC96001268	22-Jan-96	1210 CLYDESDALE (SLMMS)	UPPER MISSISSIPPI RIVER	184	GROUNDING	not noted 2	CLYDESDALE		23	STARBOARD BOW
	MC95006484	6-Mar-95	1800 MV KANSAS CITY	UPPER MISSISSIPPI RIVER	2	GROUNDING	1 per unit	M/V KANSAS CITY		S	STARBOARD BOW
	MC93003036	14-Feb-93	900 BETSY ROSS, AGRND, MI 184.1	UPPER MISSISSIPPI RIVER	184	SROUNDING	\$5,000.00	BETSY ROSS		Z	NOT NOTED
	MC97005721	18-Apr-97	1408 STARFIRE/185.5UMR (SLMMS)	UPPER MISSISSIPPI RIVER	185	MULISION	\$20,000.00	ART 385		Z	NOT NOTED
	MC97010912	27-Jun-97	2350 CECILIA CAROL/185.5 UMR(SLMMS)	UPPER MISSISSIPPI RIVER	185	MILISION	\$150,000.00	CECILIA CAROL		Z	NOT NOTED
	MC95019363	18-Apr-95	1955 CITY OF NATCHEZ	UPPER MISSISSIPPI RIVER	185	SROUNDING	\$1,000.00	OMR 2771		4	PORT BOW
	MC96016063	25-Oct-98	1420 AUSTIN GOLDING (SLMMS)	UPPER MISSISSIPPI RIVER	8	EQUIP FAIL IN	not noted 2	AUSTIN GOLDING	-	Z	NOT NOTED
Mosenthein	MC96016685	30-00-98	1600 LEVITICUS (SLMMS)	UPPER MISSISSIPPI RIVER	193	SROUNDING In	of noted 2	1416	_	מט	STARBOARD BOW
Mosenthein	MC97016018	15-00-97	150 TOM TALBERT/194.5UMR (SLMMS)	UPPER MISSISSIPPI RIVER	ğ	ROUNDING	3 per uoted	TOM TALBERT		Z	NOT NOTED
Mosenthein	MC97015849	22-04-97	710 HARVEST RUNNIMUMR (SLMMS)	UPPER MISSISSIPPI RIVER	ğ	SROUNDING	10t noted 2	HARVEST RUN		2	NOT NOTED
Mosenthein	MC97017848	18-Nov-97	345 KLJ ERICKSON/194.8UMR (SLMMS)	UPPER MISSISSIPPI RIVER	3	SROUNDING	\$40,000.00	K.L.J. ERICKSON	_	Z	NOT NOTED
Mosenthein	MC97018014	18-Nov-97	400 ADMIRAL COCKBURN/194UMR(SLMMS)	UPPER MISSISSIPPI RIVER	3	SROUNDING	\$2,500.00	WTT 857		4	PORT BOW
Mosenthein	MC97017083	24-Nov-97	445 ELIZABETH LANE/194.2UMR(SLMMS)	UPPER MISSISSIPPI RIVER	4	SROUNDING	\$31,300.00	ELIZABETH LANE		Ž	NOT NOTED
Mosenthein	MC96003709	11-Mar-96	1115 SEBRING (SLMMS)	UPPER MISSISSIPPI RIVER	191	SROUNDING	3 not noted	TS-87		ā	PORT BOW
Mosenthein	MC96016223	28-00t-88	1840 ELIZABETH BEESECKER (SLMMS)	UPPER MISSISSIPPI RIVER	Ì	SROUNDING	2 John John 3	CC-8118	-	ď.	PORT BOW
Mosenthein	MC95018784	15-Apr-95	250 STARFIRE	UPPER MISSISSIPPI RIVER	Ì	SROUNDING	\$2,500.00	XL 633B		4	PORT QUARTER
Mosenthein	_	28-Sep-93	315 COOP VENTURE GROUNDING	UPPER MISSISSIPPI RIVER	2	SROUNDING	\$0.00	XL 344		Ž	NOT NOTED
Mosenthein		25-Nov-97	300 HARVEST RUN/195.2UMR (SLMMS)	UPPER MISSISSIPPI RIVER	195	NOISION	\$6,000.00	HARVEST RUN	_	Ž	NOT NOTED
Mosenthein	MC96001812	24~Jan-96	647 KEVIN FLOWERS (SLMMS)	UPPER MISSISSIPPI RIVER	198	ILLISION IN	3 and motern	ACBL-2757		ā	PORT QUARTER
Mosenthein	MC96001812	24~Jan-96	647 KEVIN FLOWERS (SLMMS)	UPPER MISSISSIPPI RIVER	185	VLLISION IN	not noted 3	ACBL-4150		Ž	NOT NOTED
Mosenthein	MC97015724	1000	1830 SHEILA JOHNSON/195UMR (SLMMS)	UPPER MISSISSIPPI RIVER	195	GROUNDING	\$1,275.00		917	co	STARBOARD MIDSHIP HALF LENGTH
Mosenthein	MC96016959		500 BOB KOCH (SLMMS)	UPPER MISSISSIPPI RIVER	8	GROUNDING	10t noted 2	вов коск		z	NOT NOTED
	MC95019999			UPPER MISSISSIPPI RIVER	200	ALLISION IN	4 belon ton	WILLIAM F. PLETTNER		Ž	NOT NOTED
	MC93022160		1730 CRIMSON GLORY GROUNDING			GROUNDING	\$0.00	ART 164		ž	NOT NOTED
	MC93022160		1730 CRIMSON GLORY GROUNDING	UPPER MISSISSIPPI RIVER	220	GROUNDING	\$0.00	SG 624B		ž	NOT NOTED
	MC83022160		1730 CRIMSON GLORY GROUNDING	-		GROUNDING	\$0.00	SG 665B	_	ž	NOT NOTED
	MC93022160	3-Nov-931	1730ICRIMSON GLORY GROUNDING	UPPER MISSISSIPPI RIVER	220	GROUNDING	\$0.00	56 5548	1	ž	NOT NOTED

Form Approved REPORT DOCUMENTATION PAGE OMB No. 0704-0188 Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining Prublic reporting purcen for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Affington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS. 3. DATES COVERED (From - To) 2. REPORT TYPE 1. REPORT DATE (DD-MM-YYYY) October 2002 Contract report 5a, CONTRACT NUMBER 4. TITLE AND SUBTITLE DACW 39-99-P-0443 Physical Model Test for Bendway Weir Design Criteria 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER 5d PROJECT NUMBER 6. AUTHOR(S) Waterway Simulation Technology, Inc. 5e. TASK NUMBER 2791 Burnt House Road, Vicksburg, MS 39180 5f. WORK UNIT NUMBER 32256 8. PERFORMING ORGANIZATION REPORT 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NUMBER Waterway Simulation Technology, Inc., 2791 Burnt House Rd., Vicksburg, MS 39180 10. SPONSOR/MONITOR'S ACRONYM(S) 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers, Washington, DC 20314-1000; U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. 11. SPONSOR/MONITOR'S REPORT 3909 Halls Ferry Rd., Vicksburg, MS 39180-6199 NUMBER(S) ERDC/CHL TR-02-28 12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited. 13. SUPPLEMENTARY NOTES 14. ABSTRACT A typical bendway will be molded in a semi-fixed bed flume. The number of weirs, their spacing and submergence will be varied to determine the effects on tows navigating the reach. The designs will be subjected to a range of current velocities and tow sizes. Final guidance will establish minimum required depths over the weirs and recommended spacing relative to the design size tow.

15. SUBJECT TERM Bathymetry Bendway weirs	S	Hydrographic s Low water refe	•		ssippi River erged weirs
16. SECURITY CLAS	SSIFICATION OF:		17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT UNCLASSIFIED	b. ABSTRACT UNCLASSIFIED	c. THIS PAGE UNCLASSIFIED		53	19b. TELEPHONE NUMBER (include area code)